ML000009

MC02360

| Next Assembly | Used On | Revisions | | Rev | AC |
|---|---|---|---|---|---|
| | | Ltr | Description | Date | Approved |
| First Application | | A | Initial Release Rev A | 6/20/86 | SGregg |
| | | B | Revised per ECN TRN 6212, E9404, dated 2/21/87 | 3/12/87 | SGregg |
| | | C | Revised per ECN TRN 6365/DRC #F2116, dated, 9/3/87 | 10/9/87 | SGregg |
| | | D | Revised per ECN TRN 6695, DRC F5002. | 4/14/88 | SGregg |
| | | E | Revised per ECN TRN 6755, DRC F6473. | 7/25/88 | SGregg |
| | | F | Revised per ECN TRN 6909, DRC F9632. | 3/14/89 | SGregg |
| | | G | Revised per ECN TRN 7064, DRC G4672. | 1/9/90 | SGregg |
| | | H | Revised per ECN TRN 7236, DRC G6585. | 5/2/90 | SGregg |
| | | J | Revised per ECN TRN 7427, DRC H0603. | 10/23/90 | SGregg |
| | | K | Revised per ECN TRN 7550. | 3/1/91 CM Wang | SGregg |
| | | L | Revised per ECN TRN 7663. | 3/26/91 CM Wang | 3/26/91 SGregg |
| | | M | Revised per ECN TRN 7782. | 6/1/91 CM Wang | SGregg 6/1/91 |
| | | N | Revised per ECN TRN 8072. | 3/16/92 CM Wang | SGregg 3/16/92 |
| | | P | Revised per ECN TRN 8459. | CM Wang 2/24/93 | Susan Gregg 4/1/93 |
| | | R | Revised per ECN TRN 0434. | CM/AS 4/8/95 | Susan Gregg 4/9/95 |
| | | T | Revised per ECN TRP 0992. | CM/AC 4/16/96 | Susan Gregg 4/16/96 |
| | | U | Revised per ECN TRP 1916/CCR 1428 | CM/AC 3/13/97 | Susan Gregg 3/13/97 |
| | | V | Revised per ECN TRP 1817/CCR 2336. | CM/AC 5/1/97 | Susan Gregg 5/2/97 |

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CURRENT DESIGN ACTIVITY CAGE CODE 06887
LOCKHEED MARTIN SPACE SYSTEMS COMPANY
MISSILES & SPACE OPERATIONS
SUNNYVALE, CA 94088-3504

Revision Record Continued on Sheet __ 2 __

②

| CM M. Wang 5/15/90 | Contract No. NAS5-28000 Mod 04 | **RCA** | ...tion ...onics ... inceton, New Jersey |
|---|---|---|---|
| | Written: Susan Gregg  Date: 3 September 1986 | UNIQUE INSTRUMENT INTERFACE SPECIFICATION FOR THE ADVANCED MICROWAVE SOUNDING UNIT MODULE A1 (AMSU-A1) | |
| | Approved: R. M. Cummins  Date: September 8, 1986 | | |
| JM Cummins 9-15-86 Product Assurance | Approved: Date: | Size **A** | Code Ident No. **49671** | IS-2617547 |
| | | | Sheet 1 of 103 |

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## REVISIONS

| Ltr | Description | Date | Approved |
|---|---|---|---|
| V1 | Revise per ECN/TRP2376, CCR1551,QAB-VD810-0002-01. | | |
| V2 | Revise per ECN/TRP2392, CCR1563, & 8118, QAB-VD810-0009-01 | | |
| W | Incorporate ECN/TRP2376 & TRP2392, QAB-VL810-0006-01X | | |
| Y | Revised per GSFC draft task order dtd. December 1999. Wang to Word conversion, typos, LM SV format, and GE to LM references.   Reference TRP 2645, QAB-VL810-0014-01X. | 2/21/0 | |
| AA | Revise & Incorporated per EJA/ECN TRP2649; CCRs 1438B & 1632, QAB-VL810-0024-01X. | 6/16/00 | A. Fox |
| AA1 | Revise per EJA/ECN TRP2760; QAB-VD810-0033-01. CCR/2401 | 6/18/01 | |
| AB | Incorporated EJA/ECN TRP2760 and Revise and incorporate EJA/ECN TRP 2850: QAB-VL810-0043-01X. CCR's 1736, 1714A, and 8135. | 6/18/01 | |
| AC | Revised & Incorporated per ECN/TRP2768. CCR 2402A, Mod 435.   QAB-VL810-0048-01X. | 10/18/01 | |
| AB* | Corrections to Rev. AB. ECN/TRP2760, add CCR 2401. ECN/TRP2850, remove CCR 1714A.   Cover Sheet change only, no changes to text of document. | 7/24/01 | |

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TIROS

UNIQUE INTERFACE SPECIFICATION

For The

ADVANCED MICROWAVE

SOUNDING UNIT-A1 (AMSU-A1)

Approval:

GE:   Instrument Engineer

Aerojet:   Project Engineer

GE:   Systems Engineering Manager

Aerojet:   Program Manager

GE:   TIROS Program Manager

NASA:   Instrument Technical
        Officer

NASA: Instrument Manager

NASA:   Program Manager

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## 1.0 SCOPE

This document establishes the electrical, mechanical and thermal interfaces between the Advanced Microwave Sounding Unit Module A1 and the Advanced TIROS-N (ATN) Spacecraft and Aerospace Ground Equipment.

This document, in conjunction with IS-3267415, also details all environments which will be seen by the instrument from the time of its arrival at the spacecraft contractor's facility through spacecraft launch, including all phases of storage and test. In addition, specific information about unique instrument properties or requirements in associated areas (such as power and handling requirements, test requirements, test equipment, targets etc.) is contained herein.

General interface requirements, common to all instruments, are given in the General Instrument Interface Specification (IS-3267415). In the event of conflict between this specification and the General Instrument Interface Specification, this specification shall govern. Where the requirements for a particular interface parameter are omitted from this specification, the General Instrument Interface Specification requirement shall apply.

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## 2.0 APPLICABLE DOCUMENTS

The latest issue of the following document is invoked in entirety. In the event of conflict between this unique specification and the referenced general document, this unique specification shall govern.

IS-3267145    ATN-KLM General Instrument
Interface Specification (GIIS)

## 2.1 Reference Documents

The current issues of the following documents relate to the interface. Some of the documents are for reference only; others are required documents. The required documents are indicated by an asterisk. Change to these documents which affect form or function of the spacecraft interface will be submitted to the NASA TIROS Project Office for CCR action.

### 2.1.1 Spacecraft Contractor Originated Documents

| | | |
|---|---|---|
| (1) | 3278778 | Field of View Drawing* |
| (2) | 3287774 | KLM RSS Thermal Finishes* |
| (3) | 3287775 | KLM ESM Thermal Finishes* |
| (4) | 3287776 | KLM IMP Thermal Finishes* |
| (5) | 20028673 | AMSU-A1 Logic Diagram |
| (6) | 3278200 | ATN-KLM Spacecraft Assembly* |
| (7) | 3278776 | ATN-KLM ESM Assembly, GFE* |
| (8) | 3267412 | Quality Assurance Program for NOAA-KLM |
| (9) | 3267411 | Reliability Program Plan for NOAA-KLM |
| (10) | 3278779 | ATN Spacecraft Orbital Configuration |
| (11) | 3284734 | AMSU-A1 Installation |
| (12) | 8574806 | (NOAA-L) MLIB Installation |
| (13) | 8574807 | (NOAA-M) MLIB Installation |
| (14) | 8574808 | (NOAA-N) MLIB Installation |
| (15) | 8574809 | (NOAA-N') MLIB Installation |

*Required

### 2.1.2 Instrument Contractor Originated Document - Aerojet

1333964    (1) Thermal Interface Control Drawing*

Report #9175    (2) Reduced Thermal Model*

1333964    (3) Outline/Interface Control Drawing*

(4) Schematics (to first active element)

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(5) Calibration Test Equipment Requirements and Use

AE-26157       (a) STE for AMSU-A1 and A2
Report #10273   (b) AMSU-A B.B. S/C Test Targets O & M Manual

(6) Test Data Reduction and Correlation Requirements (unique to each instrument, provided with calibration log book)

AE-26156/5     (7) Instrument Calibration Procedure

AE-26357       (8) Instrument Handling and Safety Requirements

AE-26438       (9) AMSU-A Instrument Operation & Maintenance Manual (for S/N 101-104)

AE-26671       (9a) AMSU-A Instrument Operation & Maintenance Manual (for S/N 105-109)
               (10) Test Procedures

AE-26438       (a) Pre-installation Bench Checkout (O & M Manual)
Report #10273   (b) Spacecraft Thermal-Vacuum Targets
AE-26157       (c) STE (Special Test Equipment)

1333070        (11) Drill Template Drawing*

Report #9350    (12) Finite Element Model (NASTRAN)*

AS8096         (13) Connector Specification

AS26139       (14) TRIAX Connector Specification

1331367        (15) Ground Strap

T1291013      (16) Lifting Fixture

## 2.1.3 NASA Originated Documents

GSFC-S-480-13   GSFC Specification for the Advanced Microwave Sounding Unit (AMSU) S/N 101-104

GSFC-S-480-80   GSFC Specification for the Advanced Microwave Sounding Unit (AMSU) S/N 105-109

GSFC-S-480-40   Performance Assurance Requirements for the Advanced Microwave Sounding Unit-A S/N 101-104

GSFC-S-480-79   Performance Assurance Requirements for the Advanced Microwave Sounding Unit-A S/N 105-109

*Required

## 3.0 REQUIREMENTS

### 3.1 Electrical

The electrical interfaces shall comply with the General Instrument Interface Specification (IS-3267415).

### 3.1.1 Grounds

The instrument shall conform to the grounding requirements of Section 3.1.1 of the General Instrument Interface Specification, IS-3267415.

#### 3.1.1.1 Exceptions

The exceptions to the above specification are as follows:

The Triax outer shield is connected at both ends to chassis ground.

#### 3.1.1.2 Other Grounding Requirements

     1) There will be a ground strap.

### 3.1.2 Connectors

The instrument shall conform to Section 3.1.2 of the General Instrument Interface Specification, IS-3267415.

#### 3.1.2.1 Exceptions

The exceptions to the above specification are as follows:

1) Input connector requirements are as shown in Table 1. All multipin connectors are EMI/RFI filter type as specified in Aerojet Spec AS8096. Equivalent non-filter type connector list is given in Table 1. The connector finish is 6061-T6 aluminum with electroless nickel finish per MIL-C-26074.

2) Power input connector (J1) will not have ten percent spares so as to accommodate safety heater power connection.

#### 3.1.2.2 Connector Allocation

Connector requirements for the instrument shall be as shown in Table 1.

#### 3.1.2.3 Connector Mounting Hardware

Connectors J1, J2, J4, J5, J6, and J7 shall be mounted by using Cannon, ITT P/N D20418-77 Cress, screw-lock female.

#### 3.1.2.4 Connector Keying Requirements

The connector keying shall be done in a manner which guarantees that it will be impossible to improperly connect the instrument cables.

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### 3.1.2.5 Harness Mating Connectors

The mating connector requirements for the spacecraft harness shall be as shown in Table 2.

### 3.1.2.6 Pin Designations

Connector pin designations and shielding requirements for the spacecraft harness shall be as shown in Table 3.

### 3.1.2.7 Intra-Instrument Harness Requirements

NONE

### 3.1.2.8 Connector Location and Access

The interface connectors to the spacecraft harness shall be located on the -Y face of the instrument as shown in AESC drawing #1333964.

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## TABLE 1. AMSU-A1 INSTRUMENT CONNECTOR REQUIREMENTS

| Connector Name Code | Type | Description (Pins, Sex) | Function |
|---|---|---|---|
| J1 | TD1B25TP (AS8096-25PT-0) | 25 pin male | Power Input |
| J2 | TD1E9HS (AS8096-9SH-0) | 9 pin female | AIP/Digital A I/O |
| J3 | *63-47000-001 (AE26139-1) | Triax | 1.248 MHz Clock |
| J4 | TD1B25TS (AS8096-25ST-0) | 25 pin female | Commands Input |
| J5 | TD1A15TS (AS8096-15ST-0) | 15 pin female | Digital B Telemetry |
| J6 | TD1C37TP (AS8096-37PT-0) | 37 pin male | Analog Telemetry |
| J7 | TD1C37HS (AS8096-37SH-0) | 37 pin female | Test/GSE Interface |

(Aerojet Part Number)

*Automatic Connector, Inc.
Connectors P/N that begin with "TD" are filter type Cannon connectors.

### Equivalent Non-Filter Type Connector P/N

| | |
|---|---|
| J1 | DBM-25P-NMB-K56 |
| J2 | DEM-9S-NMB-K56 |
| J4 | DBM-25S-NMB-K56 |
| J5 | DAM-15S-NMB-K56 |
| J6 | DCM-37P-NMB-K56 |
| J7 | DCM-37S-NMB-K56 |

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## TABLE 2.  SPACECRAFT HARNESS CONNECTOR REQUIREMENTS FOR AMSU-A1

| S/C Designation | RCA Part No. | Type | Description (Pins, Sex) | Function |
|---|---|---|---|---|
| P1 | 1721489-3 | DBM-25S-NMB-K56 | 25 pin female | Power Input |
| P2 | 1721490-1 | DEM-9P-NMB-K56 | 9 pin male | AIP/Digital A I/O |
| P3 | 2606367-2 | RFL 6321-90(MI) | Triax | 1.248 MHz Clock |
| P4 | 1721490-3 | DBM-25P-NMB-K56 | 25 pin male | Commands Input |
| P5 | 1721490-2 | DAM-15P-NMB-K56 | 15 pin male | Digital B Telemetry |
| P6 | 1721489-4 | DCM-37S-NMB-K56 | 37 pin female | Analog Telemetry |

### TABLE 3A.   CONNECTOR PIN DESIGNATIONS–AMSU–A1

**Connector:   A1-J1 Power Input**

SPACECRAFT
AMSUA1–P1

AMSU–A1
J1

| Spacecraft (AMSUA1–P1) | Pin | AMSU–A1 (J1) |
|---|---|---|
| +28V Main Bus | 1 | +28V Main Bus |
|  | 2 | +28V Main Bus |
| +28V Main Bus Rtn | 3 | +28V Main Bus Rtn |
|  | 4 | +28V Main Bus Rtn |
| +28B Pulse Load Bus | 5 | +28V Pulse Load Bus |
|  | 6 | +28V Pulse Load Bus |
| +28V Pulse Load Bus Rtn | 7 | +28V Pulse Load Bus Rtn |
|  | 8 | +28V Pulse Load Bus Rtn |
| +28V Analog Tlm Bus | 9 | +28V Analog Tlm Bus |
| +28V Analog Tlm Bus Rtn | 10 | +28V Analog Tlm Bus Rtn |
|  | 11 | Spare |
|  | 12 | Spare |
|  | 13 | Chassis Ground |
|  | 14 | +28V Main Bus |
|  | 15 | +28V Main Bus |
|  | 16 | +28V Main Bus Rtn |
|  | 17 | +28V Main Bus Rtn |
|  | 18 | +28V Pulse Load Bus |
|  | 19 | +28V Pulse Load Bus |
|  | 20 | +28V Pulse Load Bus Rtn |
|  | 21 | +28V Pulse Load Bus Rtn |
|  | 22 | +28V Analog Tlm Bus |
|  | 23 | +28V Analog Tlm Bus Rtn |
| * | 24 | Safety Heater Power |
| * | 25 | Safety Heater Pwr Rtn |

#20 AWG Wire                    #20 AWG Wire

*Pigtails on spacecraft harness for the AMSU-A1 safety heater (for use in thermal vacuum at the spacecraft contractor).

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## TABLE 3B.   CONNECTOR PIN DESIGNATIONS AMSU-A1

### Connector:   A1-J2   AIP/Digital A I/O

SPACECRAFT
AMSUA1-P2

AMSU-A1
J2

| Pin | Designation |
|-----|-------------|
| 1 | Chassis Ground |
| 2 | Data Clock ($C_1$) |
| 3 | Signal Ground |
| 4 | Spare |
| 5 | Digital A Data Output |
| 6 | Data Enable (A1) |
| 7 | 8 Sec Sync |
| 8 | Spare |
| 9 | Spare |
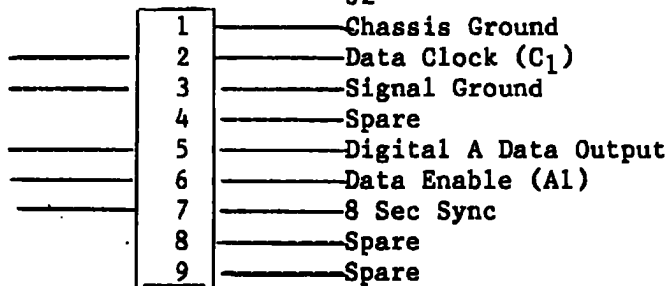
## TABLE 3C.  CONNECTOR PIN DESIGNATIONS-AMSU-A1

### Connector: A1-J3  1.248 MHz Clock

SPACECRAFT
AMSUA1-P3

AMSU-A1
J3



SOURCE

1·248 MHz CLOCK
RTN.

outer shield.

Chassis Gnd
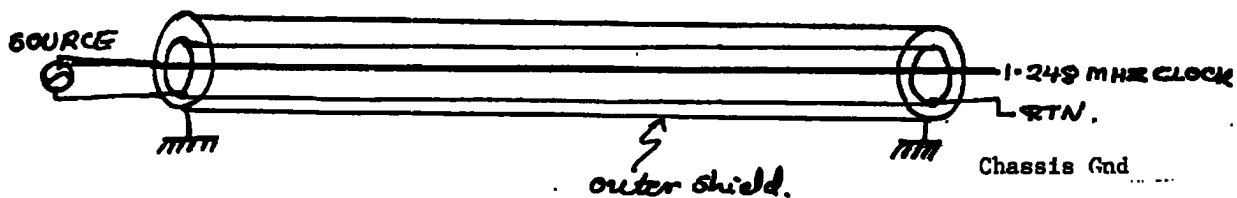
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## TABLE 3D. CONNECTOR PIN DESIGNATIONS-AMSU-A1
### Connector: A1-J4  Command

SPACECRAFT
AMSUA1-P4

AMSU-A1
J4

| Pin | Designation |
|-----|-------------|
| 1 | Chassis Ground |
| 2 | Module Power Disconnect |
| 3 | Survival Heater ON |
| 4 | Module Totally OFF |
| 5 | Scanner A1-2 ON/OFF |
| 6 | Antenna at Cold Cal Pos. |
| 7 | Phase Lock Loop Select |
| 8 | Antenna at Nadir Pos. |
| 9 | Cold Cal Pos. MSB |
| 10 | Spare |
| 11 | Spare |
| 12 | +10V Interface Bus |
| 13 | +10V Interface Bus Rtn |
| 14 | Module Power Connect |
| 15 | Survival Heater OFF |
| 16 | Scanner A1-1 ON/OFF |
| 17 | Antenna at Warm Cal Pos. |
| 18 | Full Scan |
| 19 | Cold Cal Pos. LSB |
| 20 | Spare |
| 21 | Spare |
| 22 | Spare. |
| 23 | Spare |
| 24 | +10V Interface Bus |
| 25 | +10V Interface Bus Rtn |

+10V Interface Bus — 12
+10V Interface Bus Rtn — 13

## TABLE 3E.  CONNECTOR PIN DESIGNATIONS-AMSU-A1
### Connector: A1-J5  Digital B Telemetry

SPACECRAFT
AMSUA1-P5

AMSU-A1
J5
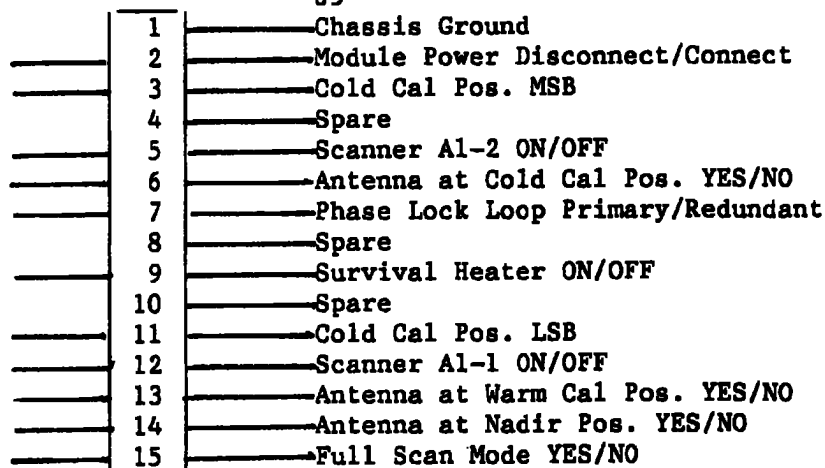
| Pin | Designation |
|-----|-------------|
| 1 | Chassis Ground |
| 2 | Module Power Disconnect/Connect |
| 3 | Cold Cal Pos. MSB |
| 4 | Spare |
| 5 | Scanner A1-2 ON/OFF |
| 6 | Antenna at Cold Cal Pos. YES/NO |
| 7 | Phase Lock Loop Primary/Redundant |
| 8 | Spare |
| 9 | Survival Heater ON/OFF |
| 10 | Spare |
| 11 | Cold Cal Pos. LSB |
| 12 | Scanner A1-1 ON/OFF |
| 13 | Antenna at Warm Cal Pos. YES/NO |
| 14 | Antenna at Nadir Pos. YES/NO |
| 15 | Full Scan Mode YES/NO |

| Size | Code Ident No. | | |
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# TABLE 3F.  CONNECTOR PIN DESIGNATIONS-AMSU-A1

Connector:  A1-J6  Analog Telemetry

SPACECRAFT
AMSUA1-P6

AMSU-A1
J6

| Pin | Designation |
|-----|-------------|
| 1 | Chassis Ground |
| 2 | RF Shelf A1-1 Temp |
| 3 | A1-1 Scan Motor Temp |
| 4 | Warm Load A1-1 Temp |
| 5 | Spare |
| 6 | PLLO Redundant (PLLO #2) "Lock Detect Signal |
| 7 | Spare |
| 8 | A1-1 Drive Motor Current (Average) |
| 9 | +15 VDC (Antenna Drive) |
| 10 | +5 VDC (Antenna Drive) |
| 11 | +15 VDC (Signal Processing) |
| 12 | +5 VDC (Signal Processing) |
| 13 | L.O. Voltage Ch3 (50.3 GHz) |
| 14 | L.O. Voltage Ch5 (53.596 GHz) |
| 15 | L.O. Voltage Ch7 (54.94 GHz) |
| 16 | +15 VDC PLL LO Ch 9/14 |
| 17 | +8.5 VDC PLL LO Ch 9/14 (S/N 101-104); +10 VDC Rcvr Mixer/IF (S/N 105-109) |
| 18 | L.O. Voltage Ch 15 (89.0 GHz) |
| 19 | Spare |
| 20 | +28V Analog Tlm Bus Rtn (STE Only)* |
| 21 | RF Shelf A1-2 Temp |
| 22 | A1-2 Scan Motor Temp |
| 23 | Warm Load A1-2 Temp |
| 24 | Spare |
| 25 | PLLO Primary (PLLO #1) "Lock Detect Signal" |
| 26 | Spare |
| 27 | A1-2 Drive Motor Current (Average) |
| 28 | -15 VDC (Antenna Drive) |
| 29 | -15 VDC (Signal Processing) |
| 30 | L.O. Voltage Ch4 (52.8 GHz) |
| 31 | L.O. Voltage Ch 6 (54.4 GHz) |
| 32 | L.O. Voltage Ch 8 (55.5 GHz) |
| 33 | -15 VDC PLL LO Ch 9/14 |
| 34 | +8 VDC (Receiver) |
| 35 | Spare |
| 36 | Spare |
| 37 | Spare |

No Connection on S/C side    20

*  For use at subsystem level testing only; not for instrument level testing.
   (Open to J1-10, shorted to J1-7).

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### 3.1.3 Power

#### 3.1.3.1 Power Sources

(1)  The main power required by the AMSU-A1 instrument shall be taken from the +28-Volt Main Bus.

(2)  The +28-Volt Pulse Load Bus shall be used to supply power to the motors and heaters in the AMSU-A1.

(3)  The +28-Volt Analog Telemetry Bus may be used for Telemetry information which is needed when the instrument is not powered and which is not critical to the mission if this bus is lost. (See Para. 3.1.3.3).

(4)  All command and Science Data Interfaces shall be powered from the +10.0-Volt Interface Bus.

(5)  The power drawn from the above sources shall not exceed values in Table 4.

#### 3.1.3.2 +28-Volt Main Bus Power Requirements

#### 3.1.3.2.1 Power Dissipation

The power required by the AMSU-A1 from the +28 Volt Main Bus shall be as shown in Table 4. The peak power worst-case profile on the +28 Volt Main Bus for this instrument shall be as shown in Figure 1.

TABLE 4.  AMSU-A1 POWER REQUIREMENTS

| +28v Main Bus | | +28v Pulse Load Bus | | +10V Bus | | +28v Analog TM Bus | |
|---|---|---|---|---|---|---|---|
| Avg. (watts) | Peak* current (amp) | Avg. (watts) | Peak current (amp) | Avg. (watts) | Peak current (amp) | Avg. (watts) | Peak current (amp) |
| 82.0 | 3.0 | 6.0 | 1.3 | 0.1 | 10mA | 0.2 | 0.007 |

* Steady-state current.

### 3.1.3.2.2 Power Limiting

The instrument shall not limit the short circuit current drain on the spacecraft +28-Volt Main Bus. The instrument will be serviced by a circuit used in the spacecraft with a 7 ampere fuse.

### 3.1.3.2.3 Load Current Ripple

The typical load current ripple on each line, which exceeds the GIIS limit, shall be as shown in Figure 2.

### 3.1.3.2.4 Transient Loads

(1) For fuse sizing purposes, the worst-case transient load on each line shall be as depicted in Figure 3.

(2) See GIIS (IS-3267415) Section 3.1.3.2.6.3. Typical load current transients shall be as shown in Figure 4.

(3) For S/N 101-104, the worst case peak current on the +28V Main Bus occurs during instrument turn-on (see Figure 1a.1) and is 10.6 amps maximum, which exceeds the GIIS (Sec. 3.1.3.2.6.4) spec of ≤ 3.0 amps peak.

For S/N 105-109, the worst case peak current on the +28V Main Bus occurs during instrument turn-on (see Figure 1a.2) and is 5.9 amps maximum, which exceeds the GIIS (Sec. 3.1.3.2.6.4) spec of ≤ 3.0 amps peak.

(4) For S/N 101-104, the rate of rise of the +28V Main Bus transient load current is 677 mA/μsec maximum, which exceeds the GIIS (Sec. 3.1.3.2.6.2) spec of ≤20mA/μsec (see Figure 1b.1).

For S/N 105-109, the rate of rise of the +28V Main Bus transient load current is 250 mA/μsec maximum, which exceeds the GIIS (Sec. 3.1.3.2.6.2) spec of ≤20mA/μsec (see Figure 1b.2).

### 3.1.3.2.5 DC/DC Converter Frequency

78 kHz (S/N 101-104)
208 kHz (S/N 105-109)

| Size | Code Ident No. | | |
|------|----------------|---|---|
| A | 06887 | | IS-2617547 |
| | | | Sheet 22 |
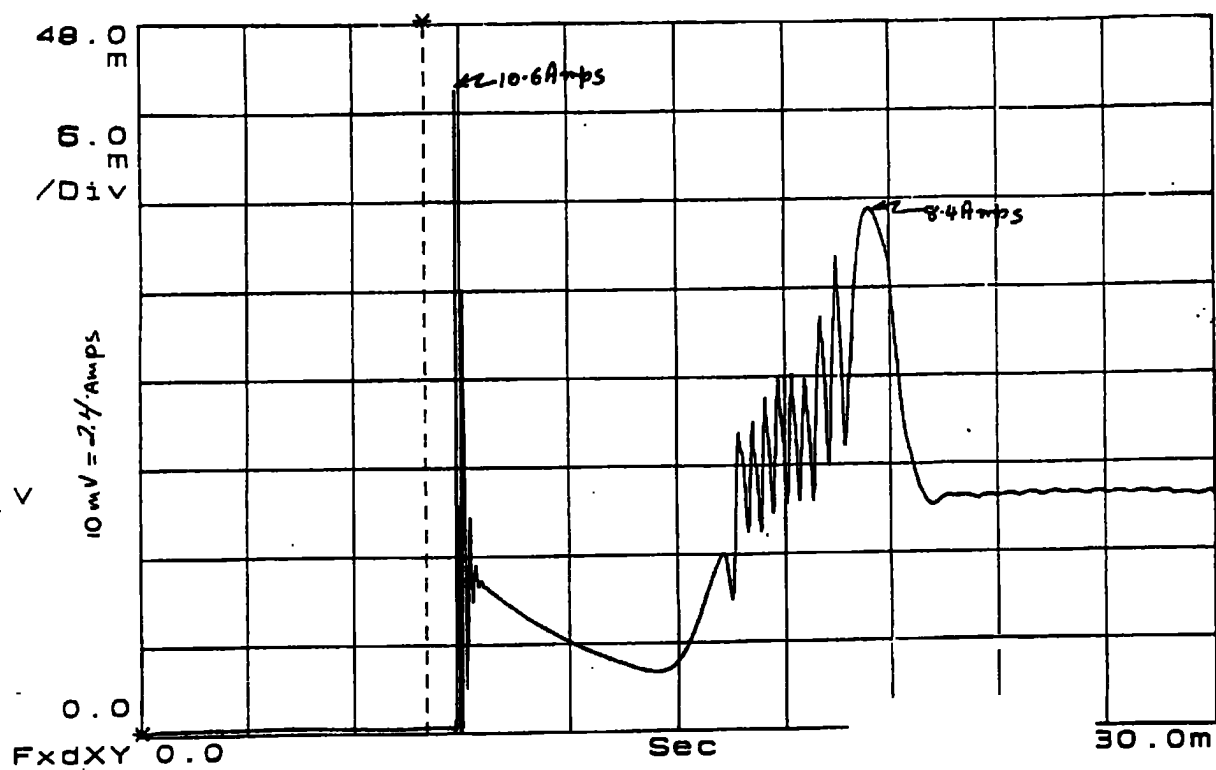
Figure 1a.1.  +28-Volt Main Bus Peak Power Worst Case Profile (S/N 101-104)

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet  23 |
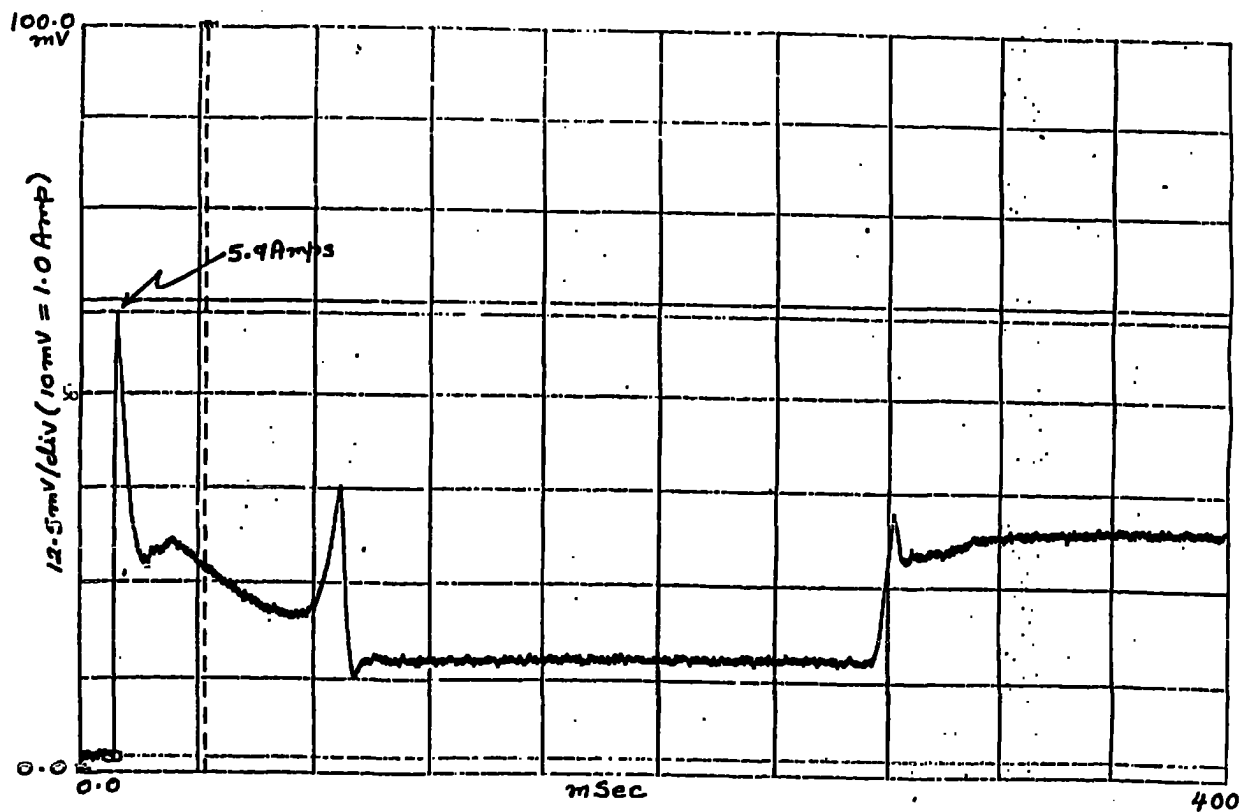
Figure 1a.2.  +28-Volt Main Bus Peak Power Worst Case Profile (S/N 105-109)

| Size | Code Ident No. | |
|---|---|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  24 |
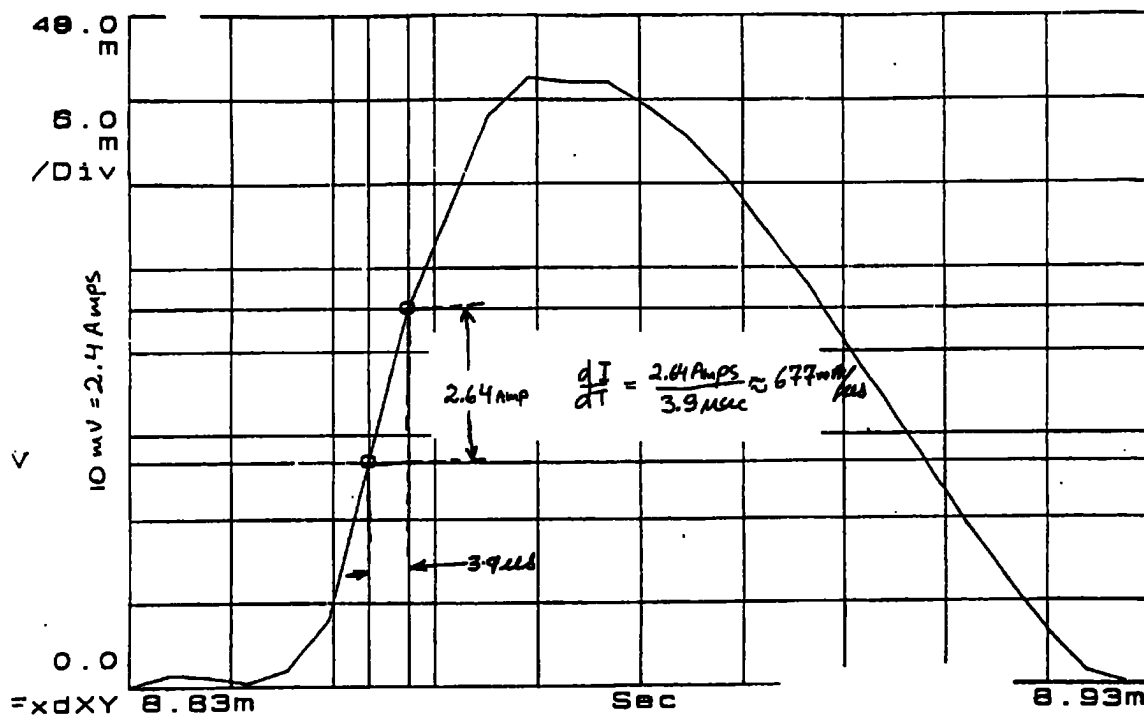
Figure 1b.1.  +28-Volt Main Bus Peak Power Worst Case Profile (S/N 101-104)

| Size | Code Ident No. | | |
|------|------|------|------|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet  25 |
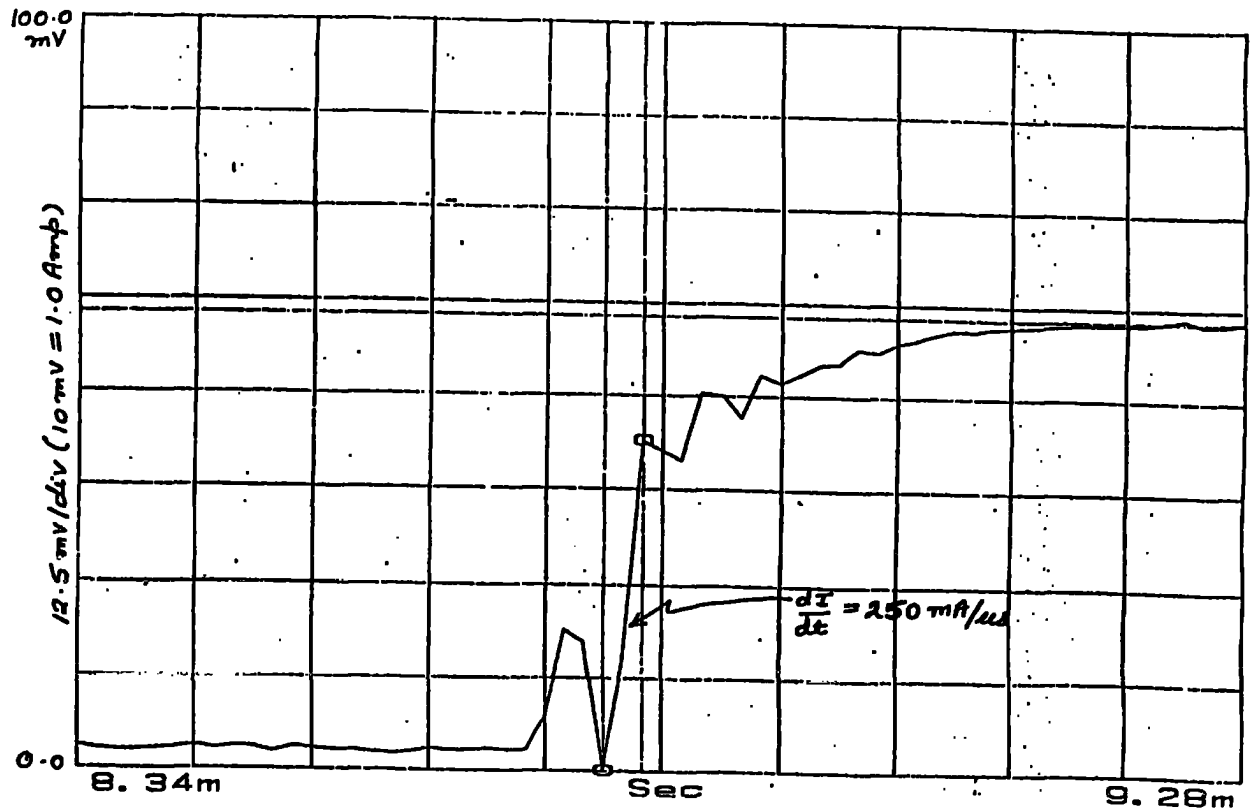
Figure 1b.2.  +28-Volt Main Bus Peak Power Worst Case Profile (S/N 105-109)

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet  26 |
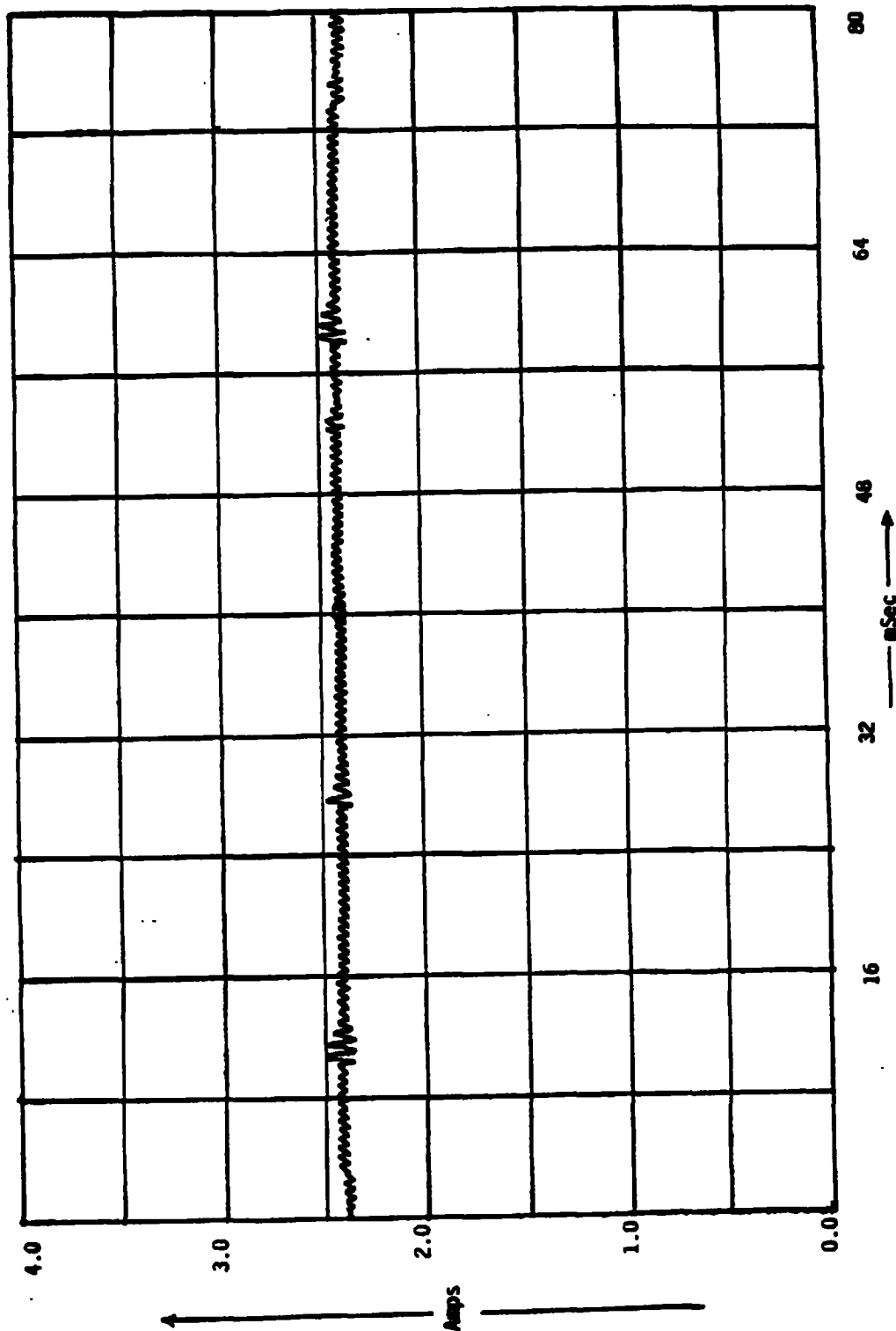
Figure 2. Typical Load Current Ripple

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 27 |

Refer to Figure 1a & 1b

Figure 3.  Worst Case Transient Load

| Size | Code Ident No. | |
|------|----------------|--|
| **A** | **06887** | IS-2617547 |
| | | Sheet  28 |

Not Applicable (In normal
in orbit operation there is no
change in load currents drawn by
the instrument.)

Figure 4.  Typical Load Current Transients

| Size | Code Ident No. | |
|---|---|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  29 |

### 3.1.3.3  +28-Volt Analog Telemetry Bus Power Requirements

The +28-Volt Analog Telemetry Bus may be used for telemetry information which is needed when the instrument is not powered and which is not critical to the mission if this Bus is lost.  Other analog Telemetry should be powered from the 28-Volt Main Bus.

### 3.1.3.3.1  Power Dissipation

The power required by the instrument from the +28-Volt Analog Telemetry Bus shall be as shown in Table 4.

There are six telemetry circuits on this bus.  The total load is included in the load for the +28-Volt Main Bus (refer to Section 3.1.3.2).

### 3.1.3.3.2  Power Limiting

The instrument shall limit the short circuit current drain on the spacecraft +28-Volt Analog Bus to 0.01 amperes.

### 3.1.3.3.3  Transient Loads

The +28-Volt Analog Telemetry Bus will be supplied to all users from a common fused circuit.  The worst-case possible loading on this bus produced by all users in combination must fall within the rating of this fused circuit.  In order to ensure that this condition is met, any transient load current drawn by the instrument from the +28-Volt Telemetry Bus, including initial power application and instrument turn-on, shall not exceed 150% of the maximum average steady-state current.

### 3.1.3.4  +28-Volt Pulse Load Bus Power Requirements

### 3.1.3.4.1  Power Dissipation

(1)  The power required by the instrument from the +28-Volt Pulse Load Bus shall be as given in Table 4.

(2)  The heater power required by the instrument, during the on-orbit non-operating condition, from the +28-Volt Pulse Load Bus shall be 40 watts for S/N 101-104 and 44 watts for S/N 105-109 (to maintain L.O. temperature above -20°C).

(3)  The peak power worst-case profile on the +28-Volt Pulse Load Bus for this instrument shall be as shown in Figure 5.  This occurs only during the turn-on following the Module Disconnect command shutdown (i.e. instrument not powered down in the normal way via Module Totally off).

### 3.1.3.4.2  Power Limiting

(1)  The instrument will be serviced by a 5 ampere rated fuse in the spacecraft.

(2)  The instrument will not limit the short circuit current drain on the spacecraft +28-Volt Pulse Load Bus.

### 3.1.3.4.3  Transient Loads

(1)  See GIIS (IS-3267415) Sections 3.1.3.4.6.1 and 3.1.3.4.6.2.

(2)  The worst case peak current on the +28V Pulse Load Bus occurs during instrument turn-on following an abnormal (Module Disconnect) shutdown (see Figure 5a) and is 11.5 amps maximum which exceeds the GIIS spec of ≤1.0 amp maximum. (This transient does not occur during normal turn-on.)

(3)  The rate of rise of the +28V Pulse Load Bus transient associated with instrument turn-on following an abnormal shutdown (see Figure 5b) is 744 mA/μsec, which exceeds the GIIS spec of ≤30mA/μsec.

(4)  Typical waveforms, including transients, for load currents drawn from the +28-Volt Pulse Load Bus during the instrument operational mode (motor stepping, survival heaters off) shall be as shown in Figure 6.

(5)  Motor current loads during the scan cycle will reach 1.3 amps which exceeds the GIIS spec of ≤1.0 amp maximum (absolute) for a period of one second or less. (See Figure 6)  Typical motor start-up current loads shall be as shown in Figure 7.
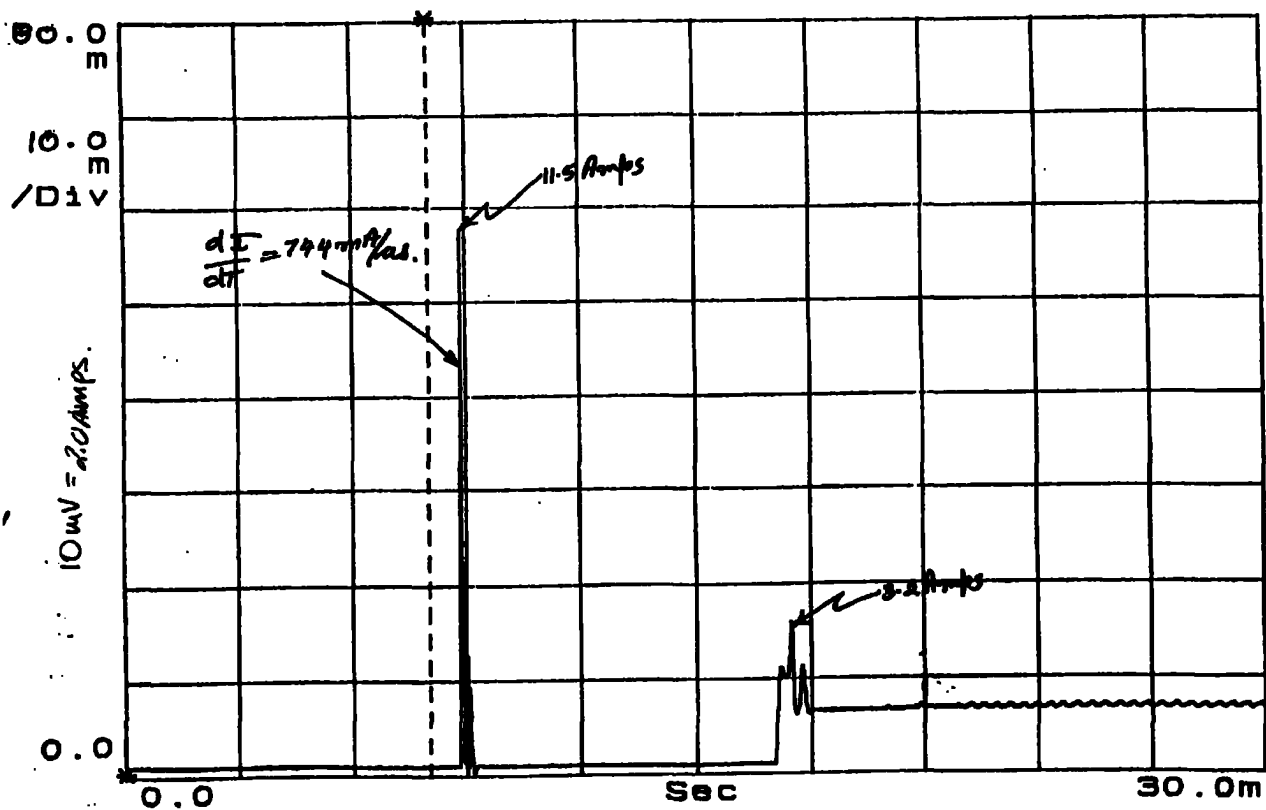


Figure 5a.  +28-Volt Pulse Load Bus Peak Power Worst-Case Profile

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 31 |
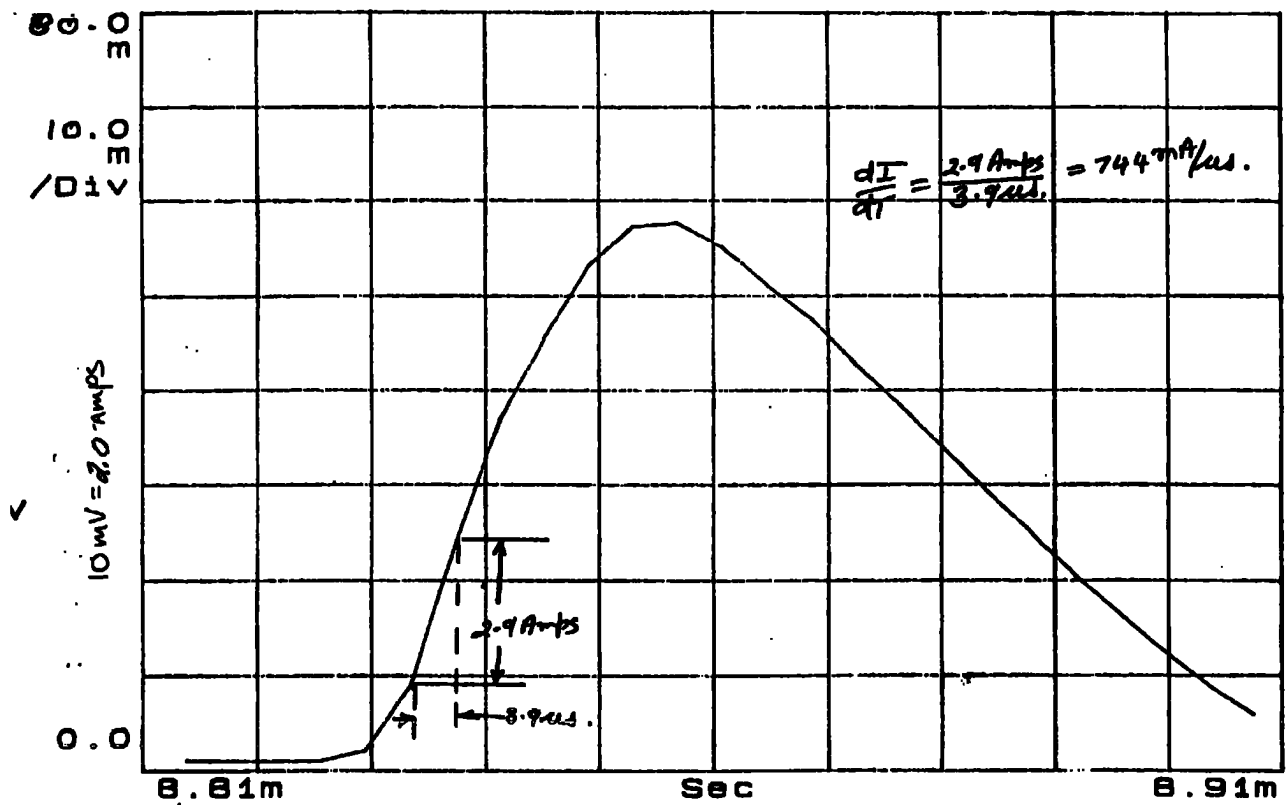
Figure 5b. +28-Volt Pulse Load Bus Peak Power Worst-Case Profile

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 32 |
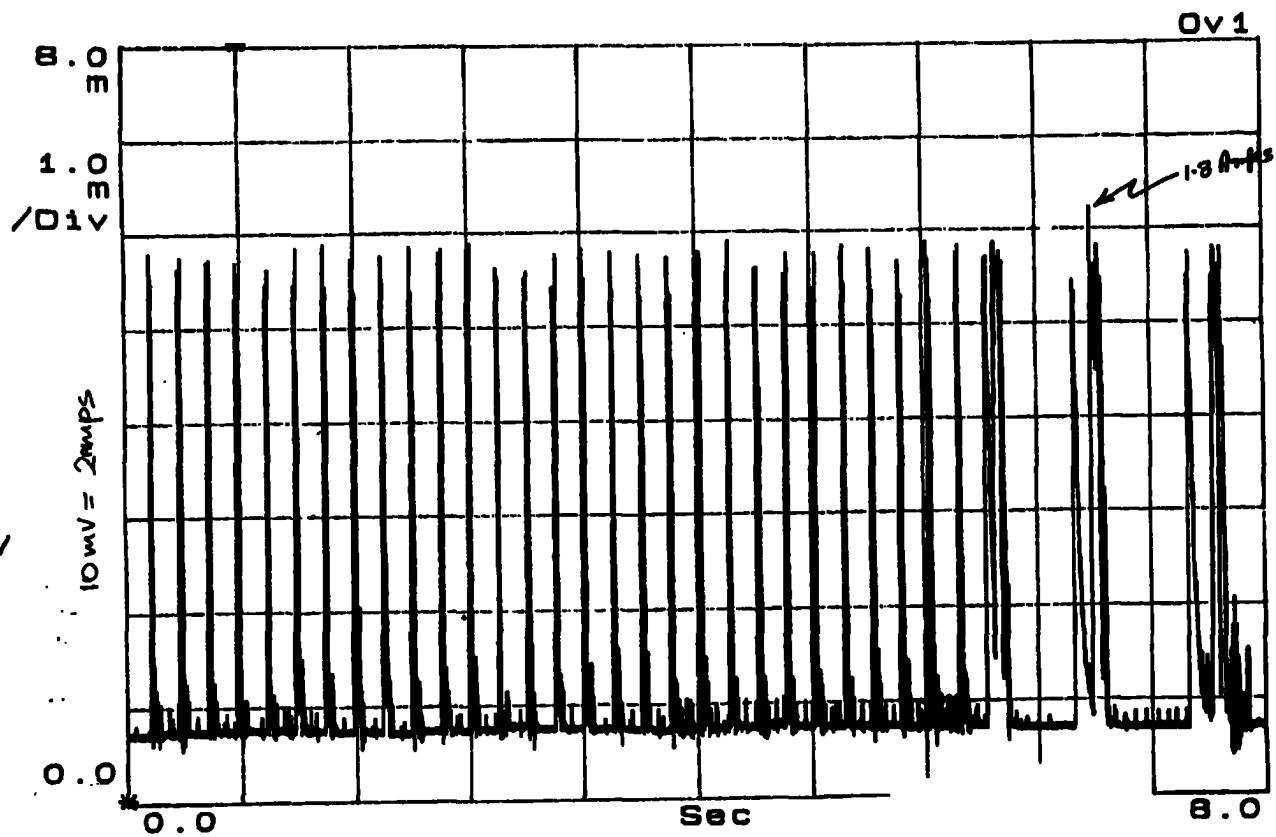
Figure 6.   +28-Volt Pulse Load BusTypical Load Current Waveform

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  33 |

Refer to Figure 6

Figure 7.  Typical Motor Start-Up Current Loads

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  34 |

### 3.1.3.5 +10.0-Volt Interface Bus Power Requirements

#### 3.1.3.5.1 Power Dissipation

The power required by the instrument from the +10.0-Volt Interface Bus shall be as given in Table 4.

#### 3.1.3.5.2 Power Limiting

The instrument shall limit the short circuit drain from the spacecraft +10-Volt bus to 100 milliamperes by use of the RC filter described in Section 3.1.3.5 of the General Instrument Interface Specification, IS-3267415.

#### 3.1.3.5.3 Transient Loads

(1)    Load current transients drawn by the instrument shall not exceed 125% of the maximum steady state current drawn from the +10-Volt bus and shall not exceed 50 milliseconds in duration.

(2)    Typical load current transients and ripple shall be as shown in Figure 8.

#### 3.1.3.5.4 Exceptions

The +10V Bus is used for Digital B signals which must correctly indicate power status with the instrument power off (Ref GIIS Section 3.1.3.5). The interface circuit is shown on Figure 9.

The +10V Interface Ground and Signal Ground as described in GIIS Section 3.1.1.1 have a common ground (S/N 102-104).
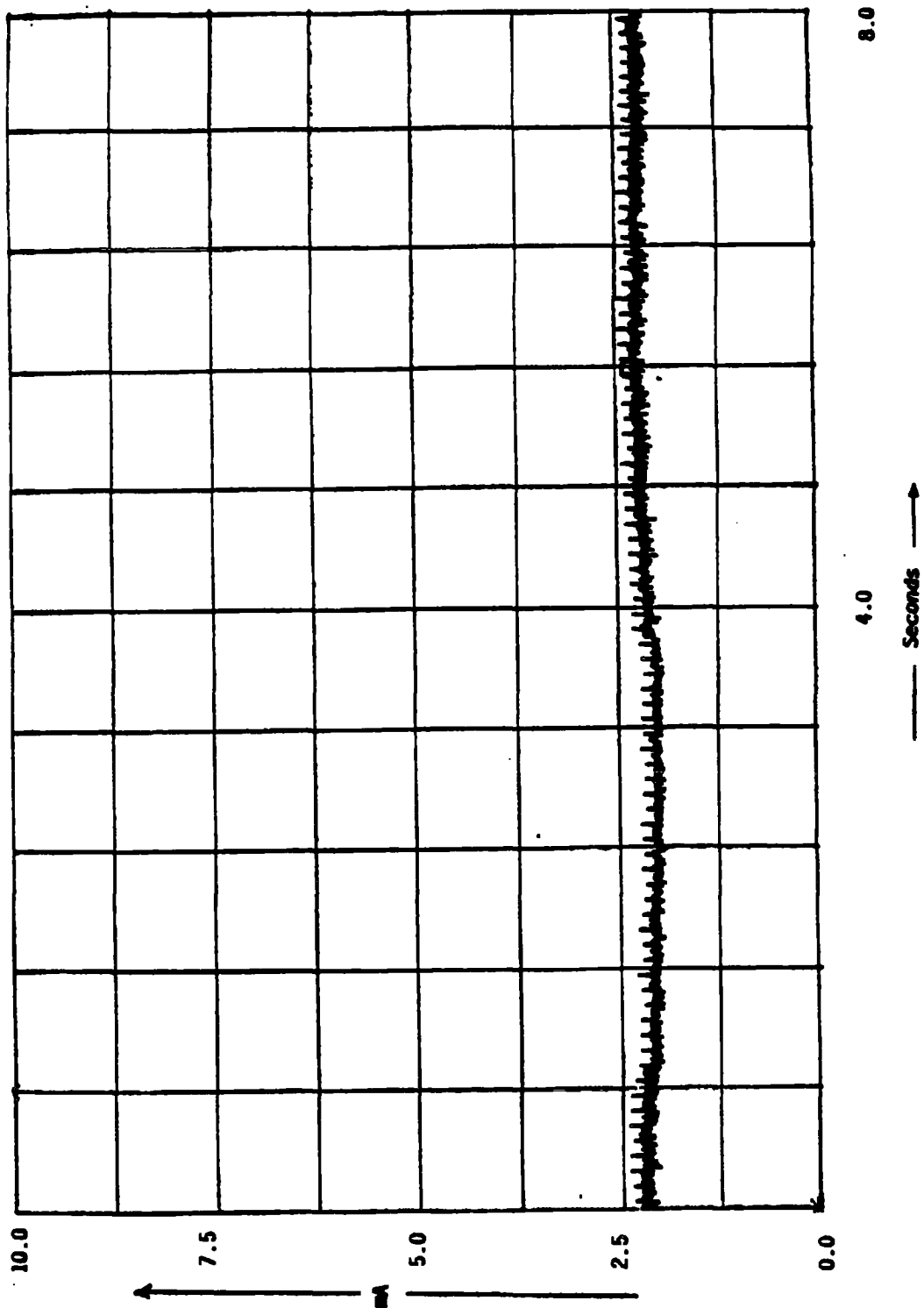
Figure 8.  Typical 10-Volt Bus Load Current Transients and Ripple

| Size | Code Ident No. | |
|---|---|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  36 |
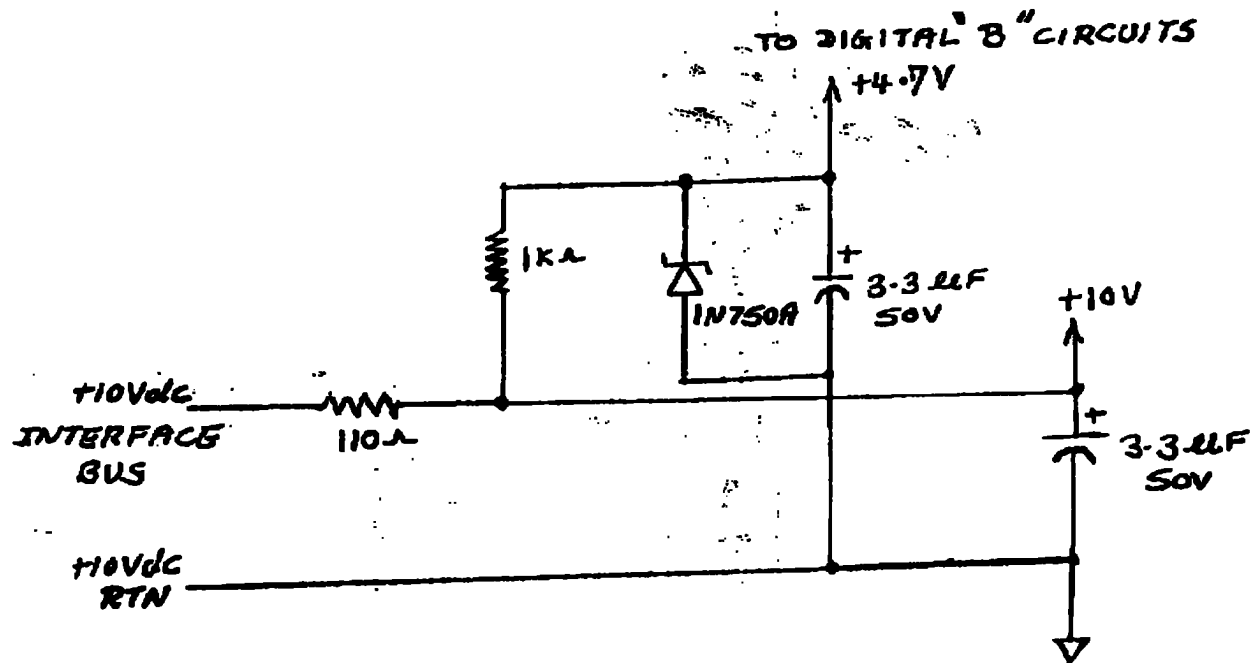
Figure 9. Schematic Diagram of Digital B Power Supply

## 3.1.3.6 Power Exceptions

The instrument shall conform to the power requirements of Section 3.1.3 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

(1)  3.1.3.2.3  The load current ripple on the +28V Main Bus exceeds two percent of the maximum average steady-state current. (See Figure 2).

(2)  3.1.3.2.4  The peak current on the +28V Main Bus is 10.6 amps (maximum) see Figure 1a.1 for S/N 101-104.  The peak current on the +28V Main Bus is 5.9 amps (maximum) see Figure 1a.2 for S/N 105-109.

(3)  3.1.3.2.4  The rise time on the +28V Main Bus is 677 mA/$\mu$sec (maximum) see Figure 1b.1 for S/N 101-104.  The rise time on the +28V Main Bus is 250 mA/$\mu$sec (maximum) see Figure 1b.2 for S/N 105-109.

(4)  3.1.3.4.3  The peak current on the +28V Pulse Load Bus associated with instrument turn-on following an abnormal shutdown is 11.5 amps (maximum).  (See Figure 5a) (This transient does not occur during normal turn-on.)

(5)  3.1.3.4.3  The rise time on the +28V Pulse Load Bus associated with instrument turn-on following an abnormal shutdown is 744 mA/$\mu$sec (maximum).  (See Figure 5b)

(6)  3.1.3.4.3  The peak current on the +28V Pulse Load Bus is 1.3 amps (maximum).  (See Figure 6)

(7)   3.1.3.5.4  The +10V Bus is used for Digital B signals which must correctly indicate power status with the instrument power off.

(8)   3.1.1.1  The +10V Interface Ground and Signal Ground have a common ground (S/N 102-104).

## 3.1.4  Input Timing and Control Signals

The spacecraft shall provide the following input timing and control signals to the instrument.  See Figure 10A.

### 3.1.4.1  Clocks

The spacecraft clocks used by the AMSU-A1 shall be as shown in Table 5.  The characteristics of these clock lines are detailed in Section 3.1.4.3 of the General Instrument Interface Specification, IS-3267415.

The function of these clocks in the instrument shall be as follows:

(1)   1.248 MHz - Synchronization of timing of instrument functions to the spacecraft clock.

   a)   Signal Processing
   b)   DC/DC Converter Frequency

### 3.1.4.2  Synchronization Signals

The spacecraft synchronization signals used by the AMSU-A shall be as shown in Table 6.  The characteristics of these sync signals are detailed in Section 3.1.4.4 of the General Instrument Interface Specification, IS-3267415.

The functions of these sync signals in the instrument are as follows:

(1)   Major Frame - Not Used

(2)   128-Second Sync - Not Used

(3)   256-Second Sync - Not Used

(4)   8-Second Sync - to synchronize the instrument output data format with the start of each AIP frame.

(5)   $A_1$ Data Enable Pulse - enables readout of AIP minor frame words.

(6)   $C_1$ Data Clock - clocks the instrument output data into the AIP.

### 3.1.4.2.1  AIP Switchover

The AMSU-A1 will continue to operate in specification if one side of the AIP fails; but, if the redundant side starts up with a random phase 8 second sync with respect to the original sync, then the instrument will be out of sync.

| Size | Code Ident No. | | |
|------|------|------|------|
| **A** | **06887** | | IS-2617547 |
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## AIP AMSU DATA INTERFACE (16.64 KBS)

(NOT TO SCALE)

1.948 MHZ CLOCK

62 SEC FRAME SYNC PULSE — 240.4 uSEC (NOT TO SCALE)

SECOND FRAME SYNC PULSE — 240.4 uSEC (NOT TO SCALE)

1.2 mSEC

AMSU SELECT INTERVAL PULSE — 881.3 uSEC (16T)

2T/5

T/5

2T/5

T/5

T = 60 uSEC = 1/16.64 KBS

AMSU DATA SHIFT PULSE

PRESENT FOR A CONTIGUOUS 18 BIT SAMPLE

REQUESTED AMSU DATA BIT AVAILABLE TO AIP — 1ST | 2ND | 3RD | 4TH | 5TH | 6TH | 7TH | 8TH | 9TH | 10TH | 11TH | 12TH | 13TH | 14TH | 15TH | 16TH

PRESENT FOR CONTIGUOUS SAMPLING ONLY

1ST | 2ND | ETC.

INSTRUMENT DATA BIT CLOCKED INTO AIP — 1ST | 2ND | 3RD | 4TH | 5TH | 6TH | 7TH | 8TH | 9TH | 10TH | 11TH | 12TH | 13TH | 14TH | 15TH | 16TH

1ST | 2ND | ETC.

NOTES:
(1) LOGIC 1 (ACTIVE LEVEL) = GROUND.
(2) INSTRUMENT DATA OUTPUT INTERFACE TO BE ACTIVE ONLY DURING SELECT INTERVAL PERIOD.
(3) TIROS-N STANDARD FAST INTERFACE WILL BE USED FOR TRANSFER OF ALL DATA AND CONTROL SIGNALS.
(4) GROUND REFERENCED TO INTERFACE GROUND.
(5) AMSU SELECT AND SHIFT PULSES ARE CLOCKED BY LOW TO HIGH TRANSITION OF THE 1.248 MHz CLOCK AND BY THE HIGH TO LOW TRANSITION OF THE 8 SECOND SYNC PULSE.
(6) DELAY FROM THE 8 SEC SYNC PULSE TO THE AMSU SELECT INTERVAL PULSE IS 1.20 mSEC +/- 30 uSEC FOR A1, 13.73 mSEC +/- 30 uSEC FOR A2, AND 26.43 mSEC +/- 30 uSEC FOR B.

Figure 10A. AIP Digital A Interface

| Size | Code Ident No. | |
|---|---|---|
| A | 06887 | IS-2617547 |
| | | Sheet 39 |

TABLE 5.  SPACECRAFT/AMSU-A1 CLOCK INTERFACES

| Clock | Signal* Characteristics | Standard Interface | Interface Logic Element | Source | Function* |
|---|---|---|---|---|---|
| 1.248 MHz | Para. 3.1.4.3.2 | High Speed | CD4000 Series | XSU | See Para. 3.1.4.1. |

*See Referenced Paragraph in IS-3267415

TABLE 6.  SPACECRAFT/AMSU-A1 SYNCHRONIZATION SIGNAL INTERFACES

| Sync | Signal Characteristics (Para)(1) | Repetition Rate | Pulse Width | Std. Interface (2) | Source |
|---|---|---|---|---|---|
| 8 sec. sync | N/A | 8 Sec. | 240.4 μsec. | B | AIP |
| $A_1$ Data Enable | N/A | 13/100 msec. | 961.5 μsec. | B | AIP |
| $C_1$ Data Clock (3) | N/A | 16.64 kHz | 12 μsec. | B | AIP |

1.  Interface circuits are A = slow   B = fast.

2.  $C_1$ delayed 10-20 μsec from $A_1$.  (Nominal Delay 12 μsec)

3.  The jitter specification between the 8 sec sync and the A1, C1 clocks shall be 50ns maximum.

3.1.4.3 Commands

3.1.4.3.1 General Requirements

The spacecraft shall provide the command inputs listed below to the AMSU-A1.  The general characteristics of these commands are detailed in Section 3.1.4.2 of the General Instrument Interface Specification, (IS-3267415).

For "Level" commands, the "ON", "TRUE", or "LOW" level will be indicated by a logic "1" or zero-volt level.  The "OFF", "FALSE", or "HIGH" level will be indicated by a Logic "0" or +10 volt level for CMOS logic.

The AMSU-A1 shall be provided 4 pulse discrete and 10 level discrete commands.  The total number of commands required by the AMSU-A1 shall be 14.

The pulse discrete commands shall have a pulse width of 60 ±5 milliseconds, which is adequate for operating relays.  The pulse discrete and level discrete commands shall be supplied from separate eight bit parallel output buffers.

All commands shall be individually verified through Digital B telemetry except for the Module Totally OFF and Module Power DISCONNECT commands which have a common Digital B indicator.

The spacecraft level AMSU-A1 command mnemonics will be as shown in Table 7.

Further details on the functions of each command are given in Table 7 and in the following paragraphs.

### 3.1.4.3.2 Command Description

PULSE DISCRETES:

1) MODULE POWER DISCONNECT. Pulse discrete command. A negative going pulse used to pulse the "off" coil of the latching relay which controls the 28 VDC regulated and 28 VDC pulsed power. Immediately removes all 28 VDC excitation from the instrument. Antenna position is unknown. State of power control relays unchanged. Highest priority command.

2) MODULE POWER CONNECT. Pulse discrete command. A negative pulse used to pulse the "on" coil of the latching relay which controls the 28 VDC regulated and 28 VDC pulsed power.

3) SURVIVAL HEATER POWER OFF. Pulse discrete command. A negative pulse used to pulse the "off" coil of the latching relay which controls the survival heaters.

4) SURVIVAL POWER HEATER ON. Pulse discrete command. A negative pulse used to pulse the "on" coil of the latching relay which controls the survival heaters.

NOTE: The operation of the survival heaters is controlled solely by the spacecraft. The instrument computer has no control upon its operation.

MICROPROCESSOR PROCESSED COMMANDS - LEVEL DISCRETE

5) MODULE TOTALLY OFF. Level discrete command. Position antennas to Warm Cal position. Turn both scanner A1-1 and A1-2 motor power to off. Remove power to both the 28 VDC regulated and pulsed busses. $\phi$ = Not Off, 1 = off.

   NOTE: If the MODULE POWER DISCONNECT command is commanded to the OFF state and then the MODULE TOTALLY OFF command is commanded to the OFF state, then the MODULE TOTALLY OFF command will be ignored.

6) SCANNER A1-1 POWER (ON/OFF). Level discrete command. Commands the control of power to Scanner A1-1. $\phi$ = Off, 1 = ON. When scanner A1-1 is off it will be positioned in the Warm Cal Position (automatic).

6a) Verify that cold cal position MSB and LSB are set.

7) SCANNER A1-2 POWER (ON/OFF). Level discrete command. Commands the control of power to scanner A1-2. $\phi$ = Off, 1 = On. When scanner A1-2 is off it will be positioned in the Warm Cal Position (automatic).

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
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8)   WARM CAL. Level discrete command. $\phi$ = No action, 1 = Command both antennas to Warm Cal position.

9)   COLD CAL. Level discrete command. $\phi$ = No action, 1 = Command both antennas to Cold Cal position.

10)  NADIR. Level discrete command. $\phi$ = No action, 1 = Command both antennas to nadir position.

11)  FULL SCAN. Level discrete command. $\phi$ = No action, 1 = Full scan mode.

NOTE: The priority in which the above 8, 9, 10 and 11 commands are executed is (highest to lowest): Full Scan Mode, Warm Cal Mode, Cold Cal Mode, and Nadir Mode.

12)  PHASE LOCK LOOP POWER. Level discrete command. 1 = Turn PLLO #1 power On, $\phi$ = Turn PLLO #2 power on.

13)  SELECT COLD CAL POSITION

   1.   Send FULL SCAN command to NO ACTION (logic 0).

   2.   Send WARM CAL command to NO ACTION (logic 0).

   3.   Send COLD CAL command to ON (logic 1).

   4.   Wait at least 18 seconds.

   5.   Send COLD CAL POSITION MSB and COLD CAL POSITION LSB command.

| MSB | LSB | | | | |
|-----|-----|----------|---|---------|--------------|
| 0 | 0 | Position | 1 | 6.667° | From -Z Axis |
| 0 | 1 | Position | 2 | 8.333° | From -Z Axis |
| 1 | 0 | Position | 3 | 9.999° | From -Z Axis |
| 1 | 1 | Position | 4 | 13.332° | From -Z Axis |

In the above level discrete commands logic level $\phi$ = false = 10 VDC, and logic level 1 = true = 0 VDC.

   6.   Wait at least 18 seconds.

   7.   Send COLD CAL command to NO ACTION (logic 0).

   8.   Send FULL SCAN command to ON (logic 1).

NOTE:  Whenever the instrument is powered down and then powered up the Cold Calibration Position will be reset to default: Cold Cal Position 1 (00).

| ITAR CONTROLLED DATA | Size | Code Ident No. | | IS-2617547 |
|----------------------|------|----------------|---|------------|
| | **A** | **06887** | | |
| | | | | Sheet  42 |

### 3.1.4.4 Exceptions

The Instrument Control Signal Interfaces shall conform to Section 3.1.5 of the General Instrument Interface Specification, IS-3267415. There are no exceptions to the above specification.

NONE

### TABLE 7. SPACECRAFT/AMSU-A1 COMMAND INTERFACES

| # | Command Name | Type | Mnemonic |
|---|---|---|---|
| 1 | Module Power Disconnect | Pulse | A1MPD |
| 2 | Module Power Connect | Pulse | A1MPC |
| 3 | Survival Heater Power OFF | Pulse | A1HPF |
| 4 | Survival Heater Power ON | Pulse | A1HPN |
| 5 | Module Totally OFF | Level | A1MTF/N |
| 6 | Scanner A1-1 Power ON/OFF | Level | A1S1N/F |
| 7 | Scanner A1-2 Power ON/OFF | Level | A1S2N/F |
| 8 | Warm Cal | Level | A1WCN/F |
| 9 | Cold Cal | Level | A1CCN/F |
| 10 | Nadir | Level | A1NAN/F |
| 11 | Full Scan | Level | A1FSN/F |
| 12 | Phase Lock Loop Power | Level | A1PLP/R |
| 13 | Cold Cal Position MSB | Level | A1CM0/1 |
| 14 | Cold Cal Position LSB | Level | A1CL0/1 |

### 3.1.5 Instrument Output Signals

### 3.1.5.1 General

The output data signals supplied by the instrument to the spacecraft shall be assignable into three categories -- instrument Digital A (Scientific) Data, Digital "B" Telemetry and Analog Telemetry. The specific signals supplied by the AMSU-A1 shall be as detailed below:

### 3.1.5.2 Digital A Data

Digital A data is clocked into the spacecraft AIP at a 16.64 kbps rate by the shift pulse (C1) whenever the Data Enable Pulse (A1) is presented to the instrument. The AMSU-A1 data will be in AIP minor frame words 8 through 33. The AIP shall read the digital A Data Output from the AMSU-A in 16 bit words.

### 3.1.5.2.1 General Requirements

(1) Content: See Figures 10B1-4
(2) Word Length: 16 bits (two 8 bit bytes)
(3) Serial Output: 13 16-bit words per 100 msec.

A1    FRAME  PARAMETER
BYTE NO.

NOTE:

| Size | Code Ident No. | | |
|---|---|---|---|
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| | | | Sheet  43 |

| Byte No. | A1 FRAME PARAMETER | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1 - 3 | Sync. Sequence (FF Hex) | | | X | | | |
| 4 | Unit Identification and Serial Number | | | X | | | |
| 5 | Digital Housekeeping Data 1 | | | X | | | |
| 6 | Digital Housekeeping Data 2 | | | X | | | |
| 7 | Digital Housekeeping Data 3 | | | X | | | |
| 8 | Digital Housekeeping Data 4 | | | X | | | |
| 9 | Reflector 1, Position 1, MSP, First reading | | | | | | |
| 10 | Reflector 1, Position 1, LSP, First reading | X | X | X | X | | |
| 11 | Reflector 2, Position 1, MSP, First reading | | | | | | |
| 12 | Reflector 2, Position 1, LSP, First reading | X | X | X | X | | |
| 13 | Reflector 1, Position 1, MSP, Second reading | | | | | | |
| 14 | Reflector 1, Position 1, LSP, Second reading | X | X | X | X | | |
| 15 | Reflector 2, Position 1, LSP, Second reading | | | | | | |
| 16 | Reflector 2, Position 1, LSP, Second reading | X | X | X | X | | |
| 17 | Scene Position 1, Channel 3, MSP | | | | | | |
| 18 | Scene Position 1, Channel 3, LSP | X | | X | | X | |
| 19 | Scene Position 1, Channel 4, MSP | | | | | | |
| 20 | Scene Position 1, Channel 4, LSP | X | | X | | X | |
| • | • | | | | | | |
| 25 | Scene Position 1, Channel 7, MSP* | | | | | | |
| 26 | Scene Position 1, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| 41 | Scene Position 1, Channel 15, MSP* | | | | | | |
| 42 | Scene Position 1, Channel 15, LSP* | X | | X | | X | |
| 43 | Reflector 1, Position 2, MSP, First reading | | | | | | |
| 44 | Reflector 1, Position 2, LSP, First reading | X | X | X | X | | |
| 45 | Reflector 2, Position 2, MSP, First reading | | | | | | |
| 46 | Reflector 2, Position 2, LSP, First reading | X | X | X | X | | |
| 47 | Rofloctor 1, Position 2, MSP, Second reading | | | | | | |
| 48 | Reflector 1, Position 2, LSP, Second reading | X | X | X | X | | |
| 49 | Reflector 2, Position 2, MSP, Second reading | | | | | | |
| 50 | Reflector 2, Position 2, LSP, Second reading | X | X | X | X | | |
| 51 | Scene Position 2, Channel 3, MSP | | | | | | |
| 52 | Scene Position 2, Channel 3, LSP | X | | X | | X | |
| • | • | | | | | | |
| 59 | Scene Position 2, Channel 7, MSP* | | | | | | |
| 60 | Scene Position 2, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| 75 | Scene Position 2, Channel 15, MSP* | | | | | | |
| 76 | Scene Position 2, Channel 15, LSP* | X | | X | | X | |
| 77 | Reflector 1, Position 3, MSP, First reading | | | | | | |
| 78 | Reflector 1, Position 3, LSP, First reading | X | X | X | X | | |
| 79 | Reflector 2, Position 3, MSP, First reading | | | | | | |
| 80 | Reflector 2, Position 3, LSP, First reading | X | X | X | X | | |
| 81 | Reflector 1, Position 3, MSP, Second reading | X | X | X | X | | |

Figure 10B-1. Digital A Data Format - Full Scan Mode

A1    FRAME  PARAMETER
BYTE NO.

NOTE:

| 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|

| Size | Code Ident No. | |
|---|---|---|
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| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 82 | Reflector 1, Position 3, LSP, Second reading | X | X | X | X | | |
| 83 | Reflector 2, Position 3, MSP, Second reading | | | | | | |
| 84 | Reflector 2, Position 3, LSP, Second reading | X | X | X | X | | |
| 85 | Scene Position 3, Channel 3, MSP | | | | | | |
| 86 | Scene Position 3, Channel 3, LSP | X | | X | | X | |
| 93 | Scene Position 3, Channel 7, MSP* | | | | | | |
| 94 | Scene Position 3, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| • | • | | | | | | |
| 1027 | Scene Position 30, Channel 15, MSP* | | | | | | |
| 1028 | Scene Position 30, Channel 15, LSP* | X | | X | | X | |
| 1029 | Reflector 1, Cold Cal. Position, MSP, First reading | | | | | | |
| 1030 | Reflector 1, Cold Cal. Position, LSP, First reading | X | X | X | X | | |
| 1031 | Reflector 2, Cold Cal. Position, MSP, First reading | | | | | | |
| 1032 | Reflector 2, Cold Cal. Position, LSP, First reading | X | X | X | X | | |
| 1033 | Reflector 1, Cold Cal. Position, MSP, Second reading | | | | | | |
| 1034 | Reflector 1, Cold Cal. Position, LSP, Second reading | X | X | X | X | | |
| 1035 | Reflector 2, Cold Cal. Position, MSP, Second reading | | | | | | |
| 1036 | Reflector 2, Cold Cal. Position, LSP, Second reading | X | X | X | X | | |
| 1037 | Cold Calibration 1, Channel 3, MSP | | | | | | |
| 1038 | Cold Calibration 1, Channel 3, LSP | X | | X | | X | |
| 1039 | Cold Calibration 1, Channel 4, MSP | | | | | | |
| 1040 | Cold Calibration 1, Channel 4, LSP | X | | X | | X | |
| 1045 | Cold Calibration 1, Channel 7, MSP* | | | | | | |
| 1046 | Cold Calibration 1, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| • | • | | | | | | |
| 1061 | Cold Calibration 1, Channel 15, MSP* | | | | | | |
| 1062 | Cold Calibration 1, Channel 15, LSP* | X | | X | | X | |
| 1063 | Cold Calibration 2, Channel 3, MSP | | | | | | |
| 1064 | Cold Calibration 2, Channel 3, LSP | X | | X | | X | |
| 1065 | Cold Calibration 2, Channel 4, MSP | | | | | | |
| 1066 | Cold Calibration 2, Channel 4, LSP | X | | X | | X | |
| 1071 | Cold Calibration 2, Channel 7, MSP* | | | | | | |
| 1072 | Cold Calibration 2, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| • | • | | | | | | |
| 1087 | Cold Calibration 2, Channel 15, MSP* | | | | | | |
| 1088 | Cold Calibration 2, Channel 15, LSP* | X | | X | | X | |
| 1089 | Temp Sensor 1, MSP | | | | | | |
| 1090 | Temp Sensor 1, LSP | X | | X | | X | X |
| 1091 | Temp Sensor 2, MSP | | | | | | |
| 1092 | Temp Sensor 2, LSP | | | | | | |
| • | • | | | | | | |
| • | • | | | | | | |
| 1177 | Temp Sensor 45, MSP | | | | | | |
| 1178 | Temp Sensor 45, LSP | | | | | | |
| 1179 | Temp Sensor Reference Voltage, MSP | | | | | | |
| 1180 | Temp Sensor Reference Voltage, LSP | | | | | | X |

Figure 10B-1. Digital A Data Format - Full Scan Mode (continued)

| Size | Code Ident No. | | |
|---|---|---|---|
| A | 06887 | | IS-2617547 |
| | | | Sheet 45 |

A1    FRAME  PARAMETER
BYTE NO.

| BYTE NO. | Parameter | NOTE: 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1181 | Reflector 1 Warm Cal. Position, MSP, First reading | | | | | | |
| 1182 | Reflector 1 Warm Cal. Position, LSP, First reading | X | X | X | X | | |
| 1183 | Reflector 2 Warm Cal. Position, MSP, First reading | X | X | X | X | | |
| 1184 | Reflector 2 Warm Cal. Position, LSP, First reading | X | X | X | X | | |
| 1185 | Reflector 1 Warm Cal. Position, MSP, Second reading | | | | | | |
| 1186 | Reflector 1 Warm Cal. Position, LSP, Second reading | X | X | X | X | | |
| 1187 | Reflector 2 Warm Cal. Position, MSP, Second reading | | | | | | |
| 1188 | Reflector 2 Warm Cal. Position, LSP, Second reading | X | X | X | X | | |
| 1189 | Warm Calibration 1, Channel 3, MSP | | | | | | |
| 1190 | Warm Calibration 1, Channel 3, LSP | X | | X | | X | |
| ⋮ | ⋮ | | | | | | |
| 1197 | Warm Calibration 1, Channel 7, MSP* | | | | | | |
| 1198 | Warm Calibration 1, Channel 7, LSP* | X | | X | | X | |
| 1213 | Warm Calibration 1, Channel 15, MSP* | | | | | | |
| 1214 | Warm Calibration 1, Channel 15, LSP* | X | | X | | X | |
| 1215 | Warm Calibration 2, Channel 3, MSP | | | | | | |
| 1216 | Warm Calibration 2, Channel 3, LSP | X | | X | | X | |
| ⋮ | ⋮ | | | | | | |
| 1239 | Warm Calibration 2, Channel 15, MSP* | | | | | | |
| 1240 | Warm Calibration 2, Channel 15, LSP* | X | | X | | X | |

| 1241-1243 | Sync. Sequence (FF Hex) |
| 1244 | Unit Identification and Serial Number |

NOTE 1:    In the above table the MSP is the most significant portion of a particular measurement while the LSP is the least significant portion of the particular measurement.

NOTE 2:    In the above table the first set of readings for a particular reflector position are made prior to the integration interval, while the second set of readings are made approximately 1/2 way through the integration period.

NOTE 3:    Digital "A" data as read by the spacecraft shall contain an undetermined number of "fill words".  These fill words shall be 0001H and will be intermingled with valid data. The Digital "A" data as sent by the instrument shall be such that no valid data of 0001H shall be included.

NOTE 4:    Format of Position data is:
DDDDDDDDDDDDDDE0
D = Data
E = Error bit, 0 = not in spec, 1 = spec.
0 = Zero

Figure 10B-1.  Digital A Data Format - Full Scan Mode (continued)

| Size | Code Ident No. | |
|---|---|---|
| A | 06887 | IS-2617547 |

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NOTE 5:    Format of Radiometer data is:
           DDDDDDDDDDDDDDD0
           D = Data
           0 = Zero

           If A/D latch up flag then format at the radiometer and temperature sensor data.

           0000000000000000

NOTE 6:    Temperature Sensor Reference Voltage utilized for temperature sensors 36-45
           only. It is used for the initial instrument performance test at instrument contractor's
           facility.

*For S/N 103 (NOAA-15) only, all scene positions, warm calibration, and cold calibration,
channel 7 and channel 15 radiometric data are interchanged; i.e., channel 7 radiometric output
is actually channel 15, and channel 15 is actually channel 7.

Figure 10B-1. Digital A Data Format - Full Scan Mode (continued)

| | Size | Code Ident No. | |
|---|---|---|---|
| | A | 06887 | IS-2617547 |
| | | | Sheet  47 |

A1 FRAME PARAMETER
BYTE NO.

| Byte No. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | NOTE: | | | | | |
| 1 - 3 | Sync. Sequence (FF Hex) | | | X | | | |
| 4 | Unit Identification and Serial Number | | | X | | | |
| 5 | Digital Housekeeping Data 1 | | | X | | | |
| 6 | Digital Housekeeping Data 2 | | | X | | | |
| 7 | Digital Housekeeping Data 3 | | | X | | | |
| 8 | Digital Housekeeping Data 4 | | | X | | | |
| 9 | Reflector 1, Warm Cal. Position, MSP, First reading | | | | | | |
| 10 | Reflector 1, Warm Cal. Position, LSP, First reading | X | X | X | X | | |
| 11 | Reflector 2, Warm Cal. Position, MSP, First reading | | | | | | |
| 12 | Reflector 2, Warm Cal. Position, LSP, First reading | X | X | X | X | | |
| 13 | Reflector 1, Warm Cal. Position, MSP, Second reading | | | | | | |
| 14 | Reflector 1, Warm Cal. Position, LSP, Second reading | X | X | X | X | | |
| 15 | Reflector 2, Warm Cal. Position, MSP, Second reading | | | | | | |
| 16 | Reflector 2, Warm Cal. Position, LSP, Second reading | X | X | X | X | | |
| 17 | Warm Cal. Position, Channel 3, MSP | | | | | | |
| 18 | Warm Cal. Position, Channel 3, LSP | X | | X | | X | |
| 19 | Warm Cal. Position, Channel 4, MSP | | | | | | |
| 20 ⋮ | Warm Cal. Position, Channel 4, LSP ⋮ | X | | X | | X | |
| 25 | Warm Cal. Position, Channel 7, MSP* | | | | | | |
| 26 ⋮ | Warm Cal. Position, Channel 7, LSP* ⋮ | X | | X | | X | |
| 41 | Warm Cal. Position, Channel 15, MSP* | | | | | | |
| 42 | Warm Cal. Position, Channel 15, LSP* | X | | X | | X | |

Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.

| Byte No. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1029 | Temp Sensor 1, MSP | | | | | | |
| 1030 | Temp Sensor 1, LSP | | | | | | |
| 1031 | Temp Sensor 2, MSP | X | | X | | X | X |
| 1032 ⋮ | Temp Sensor 2, LSP ⋮ | | | | | | |
| 1117 | Temp Sensor 45, MSP | | | | | | |
| 1118 | Temp Sensor 45, LSP | | | | | | |
| 1119 | Temp Sensor Reference Voltage, MSP | | | | | | |
| 1120 | Temp Sensor Reference Voltage, LSP | | | | | | X |

*See notes from 10B-1

Figure 10B-2. Digital A Data Format - Warm Cal Mode

ITAR CONTROLLED DATA

| Size | Code Ident No. | | |
|---|---|---|---|
| A | 06887 | IS-2617547 | |
| | | | Sheet 48 |

A1 FRAME PARAMETER
BYTE NO.

| BYTE NO. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| | | | | NOTE: | | | |
| 1-3 | Sync. Sequence (FF Hex) | | | X | | | |
| 4 | Unit Identification and Serial Number | | | X | | | |
| 5 | Digital Housekeeping Data 1 | | | X | | | |
| 6 | Digital Housekeeping Data 2 | | | X | | | |
| 7 | Digital Housekeeping Data 3 | | | X | | | |
| 8 | Digital Housekeeping Data 4 | | | X | | | |
| 9 | Reflector 1, Cold Cal. Position, MSP, First reading | | | | | | |
| 10 | Reflector 1, Cold Cal. Position, LSP, First reading | X | X | X | X | | |
| 11 | Reflector 2, Cold Cal. Position, MSP, First reading | | | | | | |
| 12 | Reflector 2, Cold Cal. Position, LSP, First reading | X | X | X | X | | |
| 13 | Reflector 1, Cold Cal. Position, MSP, Second reading | | | | | | |
| 14 | Reflector 1, Cold Cal. Position, LSP, Second reading | X | X | X | X | | |
| 15 | Reflector 2, Cold Cal. Position, MSP, Second reading | | | | | | |
| 16 | Reflector 2, Cold Cal. Position, LSP, Second reading | X | X | X | X | | |
| 17 | Cold Cal. Position, Channel 3, MSP | | | | | | |
| 18 | Cold Cal. Position, Channel 3, LSP | X | | X | | X | |
| 19 | Cold Cal. Position, Channel 4, MSP | | | | | | |
| 20 | Cold Cal. Position, Channel 4, LSP | X | | X | | X | |
| ⋮ | ⋮ | | | | | | |
| 25 | Cold Cal. Position, Channel 7, MSP* | | | | | | |
| 26 | Cold Cal. Position, Channel 7, LSP* | X | | X | | X | |
| ⋮ | ⋮ | | | | | | |
| 41 | Cold Cal. Position, Channel 15, MSP* | | | | | | |
| 42 | Cold Cal. Position, Channel 15, LSP* | X | | X | | X | |

Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.

| BYTE NO. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1029 | Temp Sensor 1, MSP | | | | | | |
| 1030 | Temp Sensor 1, LSP | | | | | | |
| 1031 | Temp Sensor 2, MSP | X | | X | | X | X |
| 1032 | Temp Sensor 2, LSP | | | | | | |
| ⋮ | ⋮ | | | | | | |
| 1117 | Temp Sensor 45, MSP | | | | | | |
| 1118 | Temp Sensor 45, LSP | | | | | | |
| 1119 | Temp Sensor Reference Voltage, MSP | | | | | | |
| 1120 | Temp Sensor Reference Voltage, LSP | | | | | | X |

*See notes from Figure 10B-1

Figure 10B-3. Digital A Data Format - Cold Cal Mode

A1  FRAME  PARAMETER
BYTE NO.

| Byte No. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1-3 | Sync. Sequence (FF Hex) | | | X | | | |
| 4 | Unit Identification and Serial Number | | | X | | | |
| 5 | Digital Housekeeping Data 1 | | | X | | | |
| 6 | Digital Housekeeping Data 2 | | | X | | | |
| 7 | Digital Housekeeping Data 3 | | | X | | | |
| 8 | Digital Housekeeping Data 4 | | | X | | | |
| 9 | Reflector 1, Position 15, MSP, First reading | | | | | | |
| 10 | Reflector 1, Position 15, LSP, First reading | X | X | X | X | | |
| 11 | Reflector 2, Position 15, MSP, First reading | | | | | | |
| 12 | Reflector 2, Position 15, LSP, First reading | X | X | X | X | | |
| 13 | Reflector 1, Position 15, MSP, Second reading | | | | | | |
| 14 | Reflector 1, Position 15, LSP, Second reading | X | X | X | X | | |
| 15 | Reflector 2, Position 15, MSP, Second reading | | | | | | |
| 16 | Reflector 2, Position 15, LSP, Second reading | X | X | X | X | | |
| 17 | Nadir Position, Channel 3, MSP | | | | | | |
| 18 | Nadir Position, Channel 3, LSP | X | | X | | X | |
| 19 | Nadir Position, Channel 4, MSP | | | | | | |
| 20 | Nadir Position, Channel 4, LSP | X | | X | | X | |
| • | • | | | | | | |
| 25 | Nadir Position, Channel 7, MSP* | | | | | | |
| 26 | Nadir Position, Channel 7, LSP* | X | | X | | X | |
| • | • | | | | | | |
| 41 | Nadir Position, Channel 15, MSP* | | | | | | |
| 42 | Nadir Position, Channel 15, LSP* | X | | X | | X | |

Bytes 9 through 42 are repeated 29 times for a total of 30 data sets.

| Byte No. | Parameter | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|
| 1029 | Temp Sensor 1, MSP | | | | | | |
| 1030 | Temp Sensor 1, LSP | | | | | | |
| 1031 | Temp Sensor 2, MSP | X | | X | | X | X |
| 1032 | Temp Sensor 2, LSP | | | | | | |
| • | • | | | | | | |
| 1117 | Temp Sensor 45, MSP | | | | | | |
| 1118 | Temp Sensor 45, LSP | | | | | | |
| 1119 | Temp Sensor Reference Voltage, MSP | | | | | | |
| 1120 | Temp Sensor Reference Voltage, LSP | | | | | | X |

*See notes from Figure 10B-1

Figure 10B-4.  Digital A Data Format - Nadir Mode

| Size | Code Ident No. | |
|---|---|---|
| A | 06887 | IS-2617547 |

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## TABLE 8.  AMSU-A1 DATA WORD DESCRIPTION

DIGITAL        HOUSEKEEPING DATA, BYTE NUMBER 1

| | BIT | DESCRIPTION |
|---|---|---|
| LSB | 0 | 0 |
| ↑ | 1 | Full Scan Mode. 0 = Not Full Scan, 1 = Full Scan |
| | 2 | Warm Cal Mode. 0 = Not in Warm Cal, 1 = Warm Cal |
| | 3 | Cold Cal Mode. 0 = Not in Cold Cal, 1 = Cold Cal |
| | 4 | Nadir Mode. 0 = Not in Nadir, 1 = Nadir |
| | 5 | Cold Cal Position, LSB |
| | 6 | Cold Cal Position, MSB |
| MSB | 7 | 0 |

DIGITAL        HOUSEKEEPING DATA, BYTE NUMBER 2

| | BIT | DESCRIPTION |
|---|---|---|
| LSB | 0 | 0. |
| ↑ | 1 | Scanner A1-1 Power 0 = Off, 1 = On. |
| | 2 | Scanner A1-2 Power 0 = Off, 1 = On. |
| | 3 | PLL Power  0  =  Redundant (PLO#2),  1  =  Primary (PLO#1). |
| | 4 | Survival Heater Power 0 = Off, 1 = On. |
| | 5 | 0. |
| | 6 | 0. |
| MSB | 7 | 0. |

DIGITAL        HOUSEKEEPING DATA, BYTE NUMBER 3

| BIT | DESCRIPTION |
|---|---|
| 0 | 0. |
| 1 | 0. |
| 2 | 0. |
| 3 | 0. |
| 4 | 0. |
| 5 | 0. |
| 6 | 0. |
| 7 | 0. |

DIGITAL        HOUSEKEEPING DATA, BYTE NUMBER 4

| BIT | DESCRIPTION |
|---|---|
| 0 | 0. |
| 1 | 0. |
| 2 | 0. |
| 3 | 0. |
| 4 | 0. |
| 5 | 0. |
| 6 | 0. |
| 7 | 0. |

TABLE 8.  AMSU-A1 DATA WORD DESCRIPTION (continued)

AMSU A1                TEMP SENSOR ASSIGNMENTS

| Number | Location |
|--------|----------|
| 1 | Scan Motor A1-1 |
| 2 | Scan Motor A1-2 |
| 3 | Feedhorn A1-1 |
| 4 | Feedhorn A1-2 |
| 5 | RF Mux A1-1 |
| 6 | RF Mux A1-2 |
| 7 | Local Oscillator Channel 3 |
| 8 | Local Oscillator Channel 4 |
| 9 | Local Oscillator Channel 5 |
| 10 | Local Oscillator Channel 6 |
| 11 | Local Oscillator Channel 7 |
| 12 | Local Oscillator Channel 8 |
| 13 | Local Oscillator Channel 15 |
| 14 | PLL LO #2 Channels 9 through 14* |
| 15 | PLL LO #1 Channels 9 through 14 |
| 16 | PLLO (Reference Oscillator) for S/N 101-104, Not Used for S/N 105-109 |
| 17 | Mixer/IF Amplifier Channel 3 |
| 18 | Mixer/IF Amplifier Channel 4 |
| 19 | Mixer/IF Amplifier Channel 5 |
| 20 | Mixer/IF Amplifier Channel 6 |
| 21 | Mixer/IF Amplifier Channel 7 |
| 22 | Mixer/IF Amplifier Channel 8 |
| 23 | Mixer/IF Amplifier Channel 9/14 |
| 24 | Mixer/IF Amplifier Channel 15 |
| 25 | IF Amplifier Channel 11/14 |
| 26 | IF Amplifier Channel 9 |
| 27 | IF Amplifier Channel 10 |
| 28 | IF Amplifier Channel 11 |
| 29 | DC/DC Converter |
| 30 | IF Amplifier Channel 13 |
| 31 | IF Amplifier Channel 14 |
| 32 | IF Amplifier Channel 12 |
| 33 | RF Shelf A1-1 |
| 34 | RF Shelf A1-2 |
| 35 | Detector/Preamplifier Assembly |
| 36 | A1-1 Warm load 1 - Not Valid for S/N 103 |
| 37 | A1-1 Warm load 2 |
| 38 | A1-1 Warm load 3 |
| 39 | A1-1 Warm load 4 |
| 40 | A1-1 Warm load center |
| 41 | A1-2 warm load 1 |
| 42 | A1-2 warm load 2 |
| 43 | A1-2 warm load 3 |
| 44 | A1-2 warm load 4 |
| 45 | A1-2 warm load center |

ITAR CONTROLLED DATA

| Size | Code Ident No. | |
|------|---------------|---|
| A | 06887 | IS-2617547 |

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TABLE 8.  AMSU-A1 DATA WORD DESCRIPTION (continued)


AMSU A-1 IDENTIFICATION WORDS

| Unit Number | Identification No. (Binary) | S/N |
|---|---|---|
| Engineering Model Module A1 | 00000001 | 101 |
| Proto Flight Model Module A1 | 00000101 | 102 |
| Flight Model 1 Module A1 | 00001001 | 103 |
| Flight Model 2 Module A1 | 00001101 | 104 |
| Flight Model 3 Module A1 | 00010001 | 105 |
| Flight Model 4 Module A1 | 00010101 | 106 |
| Flight Model 5 Module A1 | 00011001 | 107 |
| Flight Model 6 Module A1 | 00011101 | 108 |
| Flight Model 7 Module A1 | 00100001 | 109 |

**\*For S/N 102 only:**
**Read PRT temperature.** Read voltage of lock detect signal and convert to temperature using the following formula:
$t = (8.75 \times V) - 23.5$ where t is the temperature in centigrade and V is the measured lock detect voltage signal. If the temperatures given by the PRT reading and the formula are in agreement within ±5°C, then use the PRT reading as it was intended. If the temperature difference is greater than ±5°C, then use temperature interpreted from lock detect signal. At initial power on of PLLO #2 before PLLO #2 is fully self heated and stabilized, use within ±5°C rule with reference to A1-1 (PRT #33) RF-shelf temperature. The within ±5°C rule does not apply right after PLLO was operational and was switched off and then back on. In this case, wait ½ hour for PLLO #2 to cool down before temperature extraction method can be selected correctly. The formula $t = (8.75 \times V) - 23.5$ is useable only between 2.5V to +8.4V or -1.6°C to 50°C.

Figure 11.  AIP Minor Frame Format

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet 54 |

### 3.1.5.3 Digital B Telemetry

### 3.1.5.3.1 General

The Digital B one-bit status telemetry shall be available at the instrument interface at all times. The 3.2 second subcoms generated by the TIP shall sample each Digital "B" Telemetry Point once every 3.2 seconds. The characteristics of the Digital "B" telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the General Instrument Interface Specification (IS-3267415).

Words 8 and 12 of the TIP Minor Frame (AIP Minor Frame Words 111 and 115) will be dedicated to the sampling of Digital B telemetry from all spacecraft components.

### 3.1.5.3.2 Digital B Telemetry Points

Twelve Digital B Telemetry Points are required by the AMSU-A1. The Digital B Telemetry Points provided shall be as shown in Table 9.

TABLE 9. DIGITAL "B" TELEMETRY FOR AMSU-A1

| No. | Telemetry Point Name | State* Logic "1" | Logic "0" | Ch# |
|-----|----------------------|------------------|-----------|-----|
| 1 | Scanner A1-1 Power ON/OFF** | ON | OFF | 56 |
| 2 | Scanner A1-2 Power ON/OFF** | ON | OFF | 88 |
| 3 | Phase Lock Loop | PRIMARY | REDUNDANT | 120 |
| 4 | Antenna in Warm Cal Position | YES | NO | 152 |
| 5 | Antenna in Cold Cal Position | YES | NO | 184 |
| 6 | Antenna in Nadir Position | YES | NO | 216 |
| 7 | Full Scan | YES | NO | 248 |
| 8 | Survival Heater ON/OFF** | ON | OFF | 25 |
| 9 | Module Power** | CONNECT | DISCONNECT | 57 |
| 10 | Cold Cal Position MSB | See Note | | 89 |
| 11 | Cold Cal Position LSB | | | 121 |
| 12 | Spare | | | 153 |

*Logic "1" is a "Low Voltage" State
**Must correctly indicate power status with instrument power OFF.

NOTE:
| MSB | LSB | | |
|-----|-----|--------|--------|
| 0 | 0 | 6.667° | from -Z |
| 0 | 1 | 8.333° | from -Z |
| 1 | 0 | 9.999° | from -Z |
| 1 | 1 | 13.332° | from -Z |

NOTE: Cold calibration telemetry for digital "B" will be updated within 18 sec. after command receipt.

NOTE: If telemetry points 4, 5, 6 & 7 all indicate Logic "0", the instrument is operating in NO mode. In this mode, ignore digital 'A', analog TLM, and digital 'B' TLM #3, 10 & 11.

### 3.1.5.4 Analog Telemetry

#### 3.1.5.4.1 General

The Analog Telemetry needed when instrument power is off shall be available at the instrument interface at all times.

Three different subcoms types (32, 16 and 1 second) generated by the TIP will be used to sample all spacecraft analog telemetry. The characteristics of the analog telemetry interface are detailed in Sections 3.1.6, 3.1.8.2, and 3.1.8.3 of the General Instrument Interface Specification (IS-3267415). AMSU-A1 shall use the 16-second Analog subcoms.

#### 3.1.5.4.2 Analog Telemetry Points

Analog Telemetry Points used by the AMSU-A1 shall be as shown in Table 10.   Descriptions of each telemetry point are detailed below.

The AMSU-A1 shall be provided twenty-seven analog telemetry channels to monitor the health of the instrument.

#### 3.1.5.5 Exceptions

The instrument output signals shall conform to Sections 3.1.6 and 3.1.8 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

## TABLE 10. AMSU-A1 ANALOG TELEMETRY

| No. | Telemetry Point Name | Range ** | Scale Factor | Ch# (mnf#) |
|-----|---------------------|----------|--------------|------------|
| 1 | A1-1 Scanner Motor Temperature* | | | 388(4) |
| 2 | A1-2 Scanner Motor Temperature* | | | 389(5) |
| 3 | RF Shelf A1-1 Temperature* | | | 396(12) |
| 4 | RF Shelf A1-2 Temperature* | | | 397(13) |
| 5 | Warm Load A1-1 Temperature* | | | 399(15) |
| 6 | Warm Load A1-2 Temperature* | | | 403(19) |
| 7 | Antenna A1-1 Drive Motor Current (Average) | | | 404(20) |
| 8 | Antenna A1-2 Drive Motor Current (Average) | | | 406(22) |
| 9 | +15 VDC (Signal Processing) | | | 407(23) |
| 10 | +15 VDC (Antenna Drive) | | | 411(27) |
| 11 | -15 VDC (Signal Processing) | | | 412(28) |
| 12 | -15 VDC (Antenna Drive) | | | 415(31) |
| 13 | +8 VDC (Receiver Amplifiers) | | | 419(35) |
| 14 | +5 VDC (Signal Processing) | | | 420(36) |
| 15 | +5 VDC (Antenna Drive) | | | 421(37) |
| 16 | +8.5 VDC Phase Lock Loop Ch 9/14 (S/N 101-104); +10 VDC Rcvr Mixer/IF (S/N 105-109) | | | 423(39) |
| 17 | +15 VDC Phase Lock Loop Ch 9/14 | | | 427(43) |
| 18 | -15 VDC Phase Lock Loop Ch 9/14 | | | 428(44) |
| 19 | L.O. Voltage 50.3 GHz Ch 3 | | | 429(45) |
| 20 | L.O. Voltage 52.8 GHz Ch 4 | | | 431(47) |
| 21 | L.L. Voltage 53.596 GHz Ch 5 | | | 435(51) |
| 22 | L.O. Voltage 54.4 GHz Ch 6 | | | 436(52) |
| 23 | L.O. Voltage 54.94 GHz Ch 7 | | | 437(53) |
| 24 | L.O. Voltage 55.5 GHz Ch 8 | | | 439(55) |
| 25 | PLLO Redundant Lock Detect (PLLO#2) | | | 443(59) |
| 26 | PLLO Primary Lock Detect (PLLO#1) | | | 444(60) |
| 27 | L.O. Voltage 89.0 GHz Ch 15 | | | 445(61) |

\* Powered by the +28V Analog TLM Bus
\*\* Instrument S/N unique - to be provided in the instrument calibration book.

| Size | Code Ident No. | |
|------|----------------|---|
| A | 06887 | IS-2617547 |
| | | Sheet 57 |

### 3.1.6 Test Points

The test points detailed below shall be used as required by the instrument contractor during test of the AMSU-A1. The AMSU-A1 J7 connector provides test points (outputs) and GSE input commands. (Test points and GSE inputs are listed in Table 11.) These points shall not be used by the spacecraft and shall not be included in the spacecraft harness. The instrument contractor shall supply flight covers for any Test Connectors.

The Test Point Interface shall conform to Section 3.1.7 of the General Instrument Interface Specification, IS-3267415.

### 3.1.6.1 Input Test Points

Test points used for supplying test signals to the instrument shall be as shown in Table 11.

### 3.1.6.2 Output Test Points

Test points displaying signals generated within the instrument shall be as shown in Table 11.

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet 58 |

## TABLE 11. AMSU-A1 TEST POINTS AND GSE INTERFACE (A1-J7 CONNECTOR)

| Pin | Description |
|-----|-------------|
| 1 | Chassis GND |
| 2 | |
| 3 | Redundant (PLLO #2) Lock Detect |
| 4 | PLLO RTN |
| 5 | I/H and Dump RTN |
| 6 | Dump Signal |
| 7 | |
| 8 | CH 3 Analog Output Test Point |
| 9 | CH 4 Analog Output Test Point |
| 10 | CH 5 Analog Output Test Point |
| 11 | CH 6 Analog Output Test Point |
| 12 | CH 7 Analog Output Test Point |
| 13 | CH 8 Analog Output Test Point |
| 14 | CH 9 Analog Output Test Point |
| 15 | |
| 16 | |
| 17 | GSE CMD 1 LSB |
| 18 | GSE CMD 2 |
| 19 | +5V DC GSE Interlock |
| 20 | |
| 21 | |
| 22 | PRIM (PLLO #1) Lock Detect |
| 23 | |
| 24 | I/H Signal |
| 25 | |
| 26 | Analog Output RTN |
| 27 | CH 10 Analog Output Test Point |
| 28 | CH 11 Analog Output Test Point |
| 29 | CH 12 Analog Output Test Point |
| 30 | CH 13 Analog Output Test Point |
| 31 | CH 14 Analog Output Test Point |
| 32 | CH 15 Analog Output Test Point |
| 33 | |
| 34 | |
| 35 | GSE CMD 3 (MSB) |
| 36 | GSE CMD RTN (+5V RTN) |
| 37 | +5V DC GSE Interlock |

000 No Action
001 Cal Scenerio #1
010 Cal Scenerio #2
011 Cal Scenerio #3
100 Cal Scenerio #4
101 Cal Scenerio #5
110 Not Used
111 Cal Scenerio #6

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet 59 |

## 3.2 Mechanical Interface

The Instrument Mechanical Interface shall conform to Section 3.2 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

1)    Removable panel to accommodate spacecraft lifting lug (GIIS Section 3.2.2.1).

### 3.2.1 Physical Characteristics

#### 3.2.1.1 Dimensions

The nominal outside dimensions of the AMSU-A1 module, including the mounting feet, are as shown in Figure 12A. The mounting hole patterns for the AMSU-A1 module shall be as shown in Figure 12B.

The following interface data shall be indicated in the instrument configuration drawing (Aerojet Dwg. No. 1333964):

(1) Mounting hole location and tolerance
(2) Connector location and keying
(3) Center of gravity location
(4) Inertia - X, Y, and Z axes
(5) Sunshield location (if one is used)
(6) Harness tie points
(7) Identification marking
(8) Ground Strap (if required)
(9) Location of the optical mirrors
(10) Reflector location

#### 3.2.1.2 Weight

The total weight of the AMSU-A1 instrument shall not exceed 123 pounds.

#### 3.2.1.3 Moments of Inertia

The calculated moments of inertia about the center of gravity of the instrument are as follows:

| S/N 101-104: | S/N 105-109 |
|---|---|
| $I_{xx} = 8400$ lb-in$^2$ | $I_{xx} = 9114$ lb-in$^2$ |
| $I_{yy} = 6000$ lb-in$^2$ | $I_{yy} = 7351$ lb-in$^2$ |
| $I_{zz} = 10900$ lb-in$^2$ | $I_{zz} = 12587$ lb-in$^2$ |

These numbers are with the motors not operating.
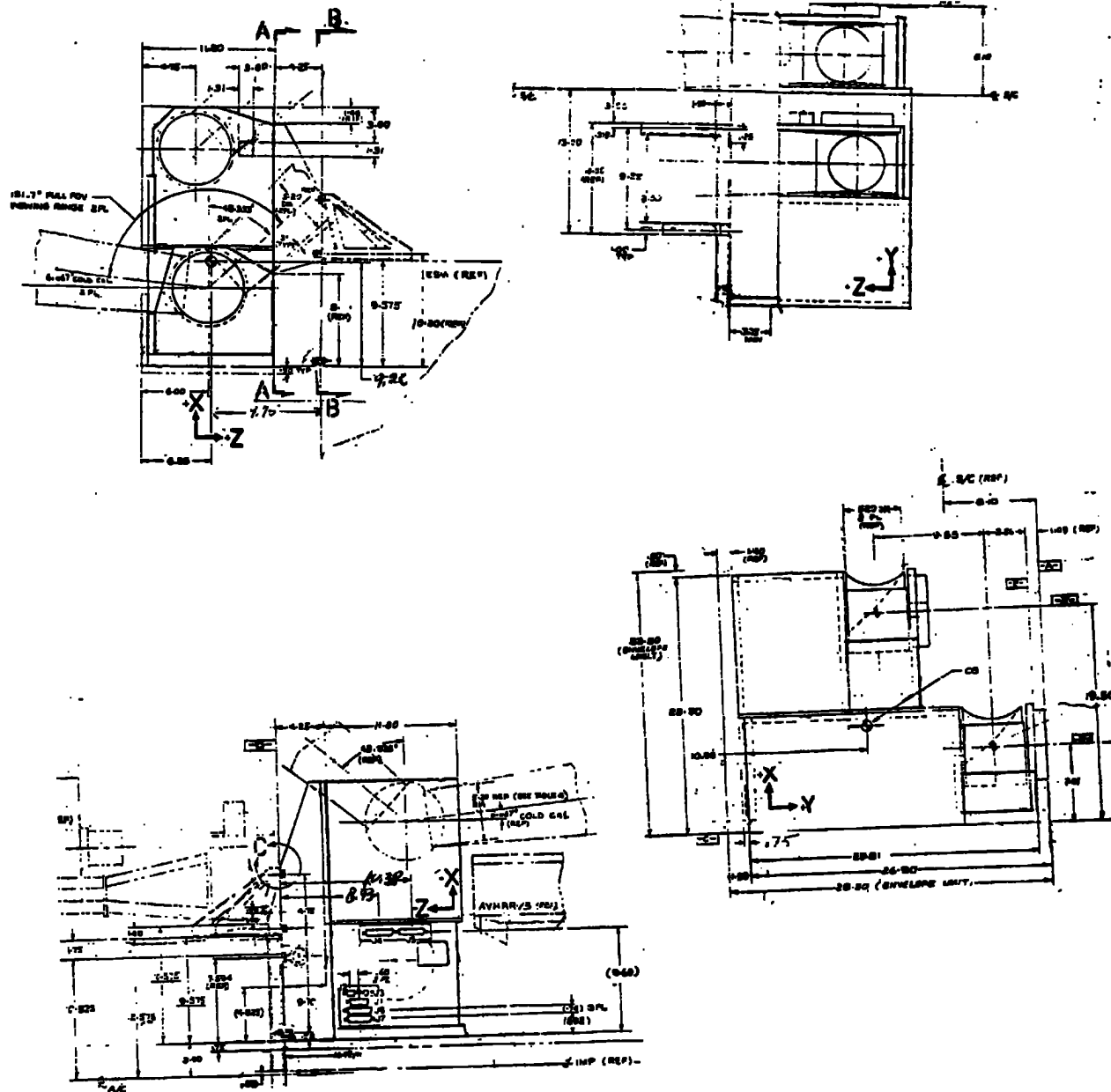
Figure 12A.  AMSU-A1 Outline Drawing

| Size | Code Ident No. | |
|------|----------------|--|
| **A** | **06887** | IS-2617547 |
| | | Sheet  61 |

VIEW B-B

INTERFACE · SIDEMOUNT ASSY AND S/C

Figure 12B. AMSU-A1 Mounting Hole Locations

### 3.2.1.4 Disturbance Torque

AMSU-A1 is uncompensated. The disturbance torque is as shown in Figures 12C. The AMSU-A1 uncompensated torque is 18.0 lb-in; the uncompensated momentum is 0.2 lb-in-sec.

### 3.2.1.5 Center of Gravity

The maximum distance from the instrument's mounting surface to the center of gravity for the AMSU-A1 module shall be less than 10.3 inches. The location of the center of gravity shall be as shown on the AMSU-A1 Outline/ Interface Control Drawing No. Aerojet 1333964.

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 62 |

Figure 12C. AMSU-A1 Torque Profile

| Size | Code Ident No. | |
|---|---|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 63 |

### 3.2.2 Instrument Mounting

#### 3.2.2.1 Instrument Mounting Surface

The instrument mounting flange surfaces shall use the boundaries defined in Para. 3.2.1. It shall be flat within 0.13 mm (0.005 inch) per Section 3.2.2.4 of the General Instrument Interface Specification, IS-3267415. Mounting interfaces on the spacecraft shall be shimmed to within 0.002 inch (max) to minimize instrument flexing.

This instrument shall utilize No. 10 (SPS Technologies 70315-3) hardware for mounting purposes. The AMSU-A1 module will be mounted to the top (-Z) surface of the ESM and to a spacecraft contractor supplied bracket which will attach to the front (+X) surface of the ESM.

TABLE 12.     PULLOUT STRENGTH AND SHEAR FORCE OF INSERT IN ESM TOP AND
EARTH-FACING PANELS

|  | Top Panel (-Z) | | Earth-Facing Panel (+X) | |
|---|---|---|---|---|
|  | Pullout Strength | Shear Force | Pullout Strength | Shear Force |
| SL601 Non-Floating Potted Insert | 398 lbs | 1629 lbs | 513 lbs | 782 lbs |

#### 3.2.2.2 Mounting Hole Position

The mounting hole positions shall be defined by the AMSU-A1 drill jig specified below:

| Jig | Drawing No. |
|---|---|
| Spacecraft Pattern | 1333070 |

This jig shall have a reference edge parallel to the spacecraft Y-Y axes.

#### 3.2.2.3 Instrument Location

The AMSU-A1 module's location and orientation on the spacecraft shall be in accordance with the following spacecraft drawings: KLM spacecraft assembly (Dwg. 3278200), KLM ESM assembly (Dwg. 3278776), and KLM Field of View (Dwg. 3278778).

#### 3.2.2.4 Spacecraft Mounting Surface

The spacecraft mounting surface shall conform to the requirements of Section 3.2.2.3 of the General Instrument Interface Specification, IS-3267415.

| Size | Code Ident No. | |
|---|---|---|
| A | 06887 | IS-2617547 |
|  |  | Sheet 64 |

### 3.2.3 Mechanisms

NONE

### 3.2.4 Fields-of-View

#### 3.2.4.1 Instrument Requirements

The clear fields-of-view required by the instrument are defined below and as shown in Figures 13A and 13B. The "Earth", "Nadir", or "+X" direction shall be the "0" degree reference. The spacecraft velocity vector is in the "-Y" direction.

In front of each antenna, there shall be a zone clear of any obstructions. This zone shall be a truncated right circular cone, emanating from the aperture of the antenna, $D_A$, and expanding with the distance, $Z_A$, from the aperture according to the expression:

$$D_z = D_A + 2 Z_A \tan \theta_1$$

where $D_z$ is the cone diameter at any distance $Z_A$ and $\theta_1$ is the half cone angle.
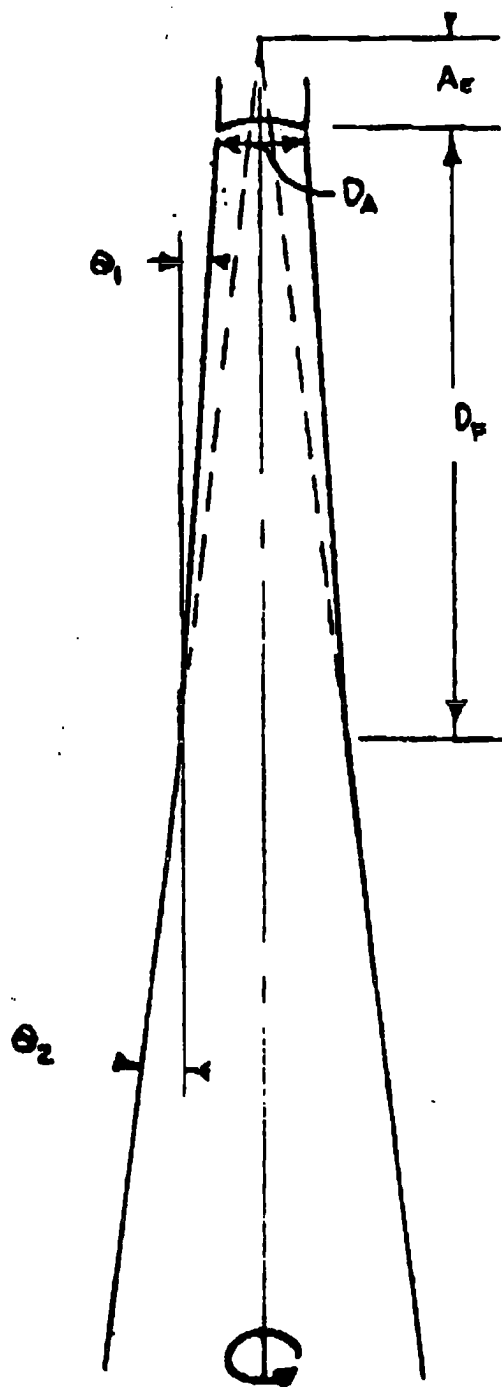
At a distance from the aperture such that $Z_A$ is greater than or equal to $D_F$, the half cone angle shall be $\theta_2 = 2 \theta_1$.

The aperture is defined as being at a distance $A_E$ in front of the axis of rotation.

| Module | $D_A$ (inches) | $\theta_1$ (degrees) | $D_F$ (inches) | $A_E$ (inches) |
|--------|--------|--------|--------|--------|
| A1 | 6 | 3.50 | 42 | 4 |

$D_A$ - antenna aperture diameter

$A_E$ - distance to axis of rotation

$D_F$ - distance to full cone angle FOV

$\Theta_1$ - $\frac{1}{2}$ · full half-cone angle F.O.V.

$\Theta_2$ - full half-cone angle F.O.V.

| | AMSU A1 |
|---|---|
| $D_A$ | 6" |
| $A_E$ | 4" |

$$\Theta_2 = 2 \cdot \Theta_1$$

$$\Theta_1 = 3.5°$$

$$D_F = \frac{D_A/2 - A_E \tan \Theta_2}{\tan \Theta_2 - \tan \Theta_1}$$

Figure 13A. AMSU-A1 F.O.V. Requirements (cross-track) and down-track) for all beam positions #1 through #30 and cold calibration.
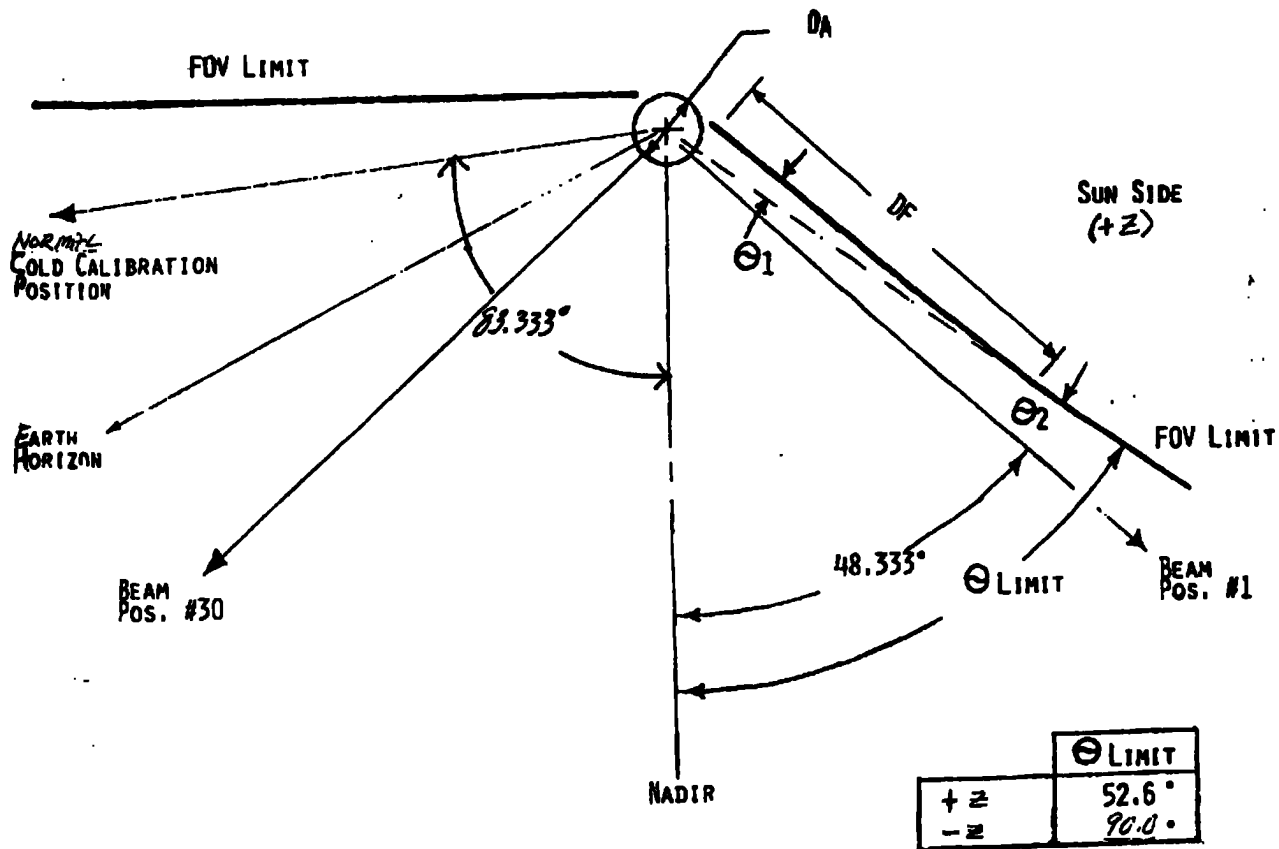
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| Size | Code Ident No. | |
|---|---|---|
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Figure 13B.  AMSU-A1 FOV Crosstrack Scan Profile

| Size | Code Ident No. | |
|---|---|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet  67 |

### 3.2.4.2 Spacecraft Provisions

The spacecraft shall provide unobstructed fields-of-view as defined in Section 3.2.4.1.

### 3.2.5 Alignment

The instrument alignment shall be in accordance with Section 3.2.3 of the General Instrument Interface Specification, IS-3267415, and shall meet the following requirements:

The in-orbit uncertainties are shown in Table 13A and include uncertainties due to launch, gravity and thermal gradients. The determination of these uncertainties for the AMSU instruments are based on previous analysis. It is expected that the possible movement of the AMSU-A1 and A2 modules due to vibration or launch will be less than shown due to the utilization of shear pins between the module base and the ESM.

To provide for the best possible coregistration between AMSU modules, repositioning of the modules will be required during the initial alignment sequence. The AMSU-A2 module will utilize spacecraft contractor supplied interface plates when mounted to the spacecraft. These plates have been designed to have oversized mounting holes which are required to allow for maximum adjustment (rotation) about the X-axis. The AMSU-B module, as designed, does not allow for maximum adjustment (rotation) about the X-axis. Adjustment of the AMSU-A2 and -B modules about the Y- and Z-axes will be accomplished via shimming. The AMSU-A1 module, as designed, does not allow for maximum adjustment (rotation) about the Z-axis. Adjustment of the AMSU-A1 module about the X- and Y-axes will be accomplished via shimming.

To utilize the available adjustments in the AMSU modules and provide for the best coregistration between modules, the following alignment scenerio will be performed:

The AMSU-A1 module will be aligned relative to the primary reference axis (as defined by the ESA) with an initial placement of 0.05 degrees or less in the X- and Y-axes. AMSU-A1 will be placed, accepting the Z-axis position. AMSU-A2 will then be aligned relative to the AMSU-A1 module with an initial placement of 0.05 degrees or less in all three axes. The AMSU-B module will be placed, accepting the X-axis position. AMSU-B will then be aligned relative to the AMSU-A1 module with an initial placement requirement of 0.05 degrees or less in the Y- and Z-axes. The worst case on ground coregistration between the AMSU modules and the ESA will be as shown in Table 13B. Using this method the AMSU modules will be able to meet the in-orbit alignment requirements relative to the primary reference axis as shown in Table 13C with an in-orbit coregistration between the AMSU modules and the ESA as shown in Table 13D.

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| Size | Code Ident No. | | |
|------|----------------|---|---|
| A | 06887 | | IS-2617547 |
| | | | Sheet 68 |

#### TABLE 13A. AMSU ON-ORBIT UNCERTAINTIES (WRT ESA)

| INST. | A | B | C | D | E | F | G | H | I | RSS |
|-------|-----|---|------|--------|--------|-------|------|-------|--------|--------|
| A1 | 0.1 | 0 | 0.05 | 0.0014 | 0.0014 | 0.028 | 0.05 | 0.025 | 0.0014 | 0.1281 |
| A2 | 0.1 | 0 | 0.05 | 0.0014 | 0.0014 | 0.028 | 0.05 | 0.083 | 0.0014 | 0.1506 |
| B | 0.1 | 0 | 0.05 | 0.0014 | 0.0014 | 0.028 | 0.05 | 0.083 | 0.0014 | 0.1506 |

INSTRUMENT

A: KNOWLEDGE OF INST MIRROR WRT ELECTRICAL BORESIGHT AXIS

B: REPEATABILITY OF INST MIRROR PLACEMENT

C: CHANGE IN INST ELECTRICAL BORESIGHT AXIS DUE TO ENV TEST

SPACECRAFT

D: MEASUREMENT TOLERANCE FROM RPPA TO ESA MIRROR

E: REPEATABILITY OF ESA MIRROR

F: UNCOMPENSATED GRAVITATIONAL TOLERANCE BETWEEN INST

G: CHANGE IN POSITION DUE TO LAUNCH

H: CHANGE IN POSITION TO ON ORBIT THERMAL GRADIENTS

I: MEASUREMENT TOLERANCE FROM RPPA TO INST. MIRROR

#### TABLE 13B. AMSU INITIAL GROUND COREGISTRATION

| Instrument | Initial Placement (Max) | Initial Placement (RSS'D) |
|-----------|-------------------------|---------------------------|
| ESA/AMSU-A1 | 0.05° | 0.05° |
| ESA/AMSU-A2 | 0.10° | 0.07° |
| ESA/AMSU-B | 0.10° | 0.07° |
| AMSU-A1/AMSU-A2 | 0.05° | 0.05° |
| AMSU-A1/AMSU-B | 0.05° | 0.05° |
| AMSU-A2/AMSU-B | 0.10° | 0.07° |

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
| | | Sheet 69 |

## TABLE 13C.  AMSU ALIGNMENT REQUIREMENTS (WRT ESA)

| Inst. | Initial Position (1) | Max Alignment Shift Due To Vib (2) | Final Position | Uncertainty (3) | Calculated Requirement |
|---|---|---|---|---|---|
| AMSU-A1 | < 0.05° | +/- 0.05° | < 0.1° | +/- 0.13° | 0.23° |
| AMSU-A2 | < 0.10° | +/- 0.05° | < 0.15° | +/- 0.15° | 0.30° |
| AMSU-B | < 0.10° | +/- 0.05° | < 0.15° | +/- 0.15° | 0.30° |

(1)  Sensor Optical Axes WRT S/C Primary Axis

(2)  Sensor Reference Axes WRT S/C Primary

(3)  From RSS'D Uncertainty in Table 13A


## TABLE 13D.  AMSU IN-ORBIT COREGISTRATION

| Instrument | Final Position | Uncertainty | In-Orbit Coregistration |
|---|---|---|---|
| ESA/AMSU-A1 | 0.10° | 0.13° | 0.23° |
| ESA/AMSU-A2 | 0.15° | 0.15° | 0.30° |
| ESA/AMSU-B | 0.15° | 0.15° | 0.30° |
| | | | |
| AMSU-A1/AMSU-A2 | 0.10° | 0.20° | 0.30° |
| AMSU-A1/AMSU-B | 0.10° | 0.20° | 0.30° |
| AMSU-A2/AMSU-B | 0.15° | 0.21° | 0.36° |

### 3.2.5.1 Reference Surfaces

The instrument and alignment reference surfaces (alignment cube) shall be compatible with Section 3.2.3.3 of the General Instrument Interface Specification, IS-3267415.

   (1)   Alignment Reference Position with Respect to Optical Axis:  Each reference surface shall be placed normal to one of the three planes used to define the instrument optical axis and placed so that it may be sightable from the +Y and +X axes.

   (2)   Size:  1" diameter minimum

   (3)   Orientation:  See Aerojet drawing no. 1333964

   (4)   Flatness:  1/4 wave visible

### 3.2.6 Protective Covers

Protective covers for the antennae shall be required for the AMSU-A1 module as follows:

Protective covers shall be installed over the rotating portion of the antennas.  The covers shall be designed such that the antennas can rotate with the covers in place.  These covers shall be non-flight.

These covers shall meet the specifications in Section 3.2.11 of the General Instrument Interface Specification (IS-3267415) with no exceptions granted.

### 3.2.6.1 Accessibility

Paragraph 3.2.11 of the General Instrument Interface Specification applies without exception.

### 3.2.6.2 Installation Requirements

Paragraph 3.2.11 of the General Instrument Interface Specification applies without exception.

### 3.2.6.3 Removal Requirements and Reasons

Protective covers shall be removed at the launch site prior to mating with the launch vehicle fairing.  The IS-3267415 requirement for covers which are "removable with one hand at the launch site after complete spacecraft assembly and mating to the launch vehicle" is no longer applicable.

### 3.2.6.4 Precautions

The handling precautions shall be as specified in AE-26357, AMSU-A1 and -A2 Handling Procedure.

### 3.2.7 Instrument Materials and Finishes

The instrument materials and finishes shall comply with the General Instrument Interface Specification.

### 3.2.8 Spacecraft Harness Clamp Requirements

There is no requirement for the instrument vendor to install a spacecraft harness clamp on the instrument. If a harness tie-down clamp is required, it will be potted to the instrument, within the cable routing zone as indicated on Aerojet Drawing #1333964, at the time of integration of the instrument with the spacecraft.

### 3.2.9 Marking

Identification and marking shall be in accordance with Section 3.3.7 of the General Instrument Interface Specification, IS-3267415. The following information shall be provided for the AMSU-A1. This marking shall be visible when the instrument is mounted on the spacecraft (with thermal blankets not in place).

> Equipment Nomenclature
> Serial Number
> Contract (or Purchase Order) Number
> Manufacturer's Name or Trademark
> Manufacturer's Part Number

### 3.3 Thermal Interface

The basic characteristics of the instrument/spacecraft (ESM) interface and the requirements necessary to establish and maintain this interface shall be as follows.

### 3.3.1 Responsibility

#### 3.3.1.1 Instrument Vendor

The instrument vendor shall be responsible for the thermal design of the instrument.

The instrument vendor shall furnish to the spacecraft contractor a complete documentation package clearly defining the physical outline of the instrument, its multilayered insulation blankets, fixed-area radiators, its louver/radiator assemblies (if any) and its mounting scheme. This documentation shall consist of a set of fully annotated drawings. Refer to Section 4.6.3.6 of GSFC-S-480-13 (S/N 101-104) and GSFC-S-480-80 (S/N 105-109).

The instrument vendor shall furnish to the spacecraft contractor a reduced thermal model of the instrument for the purposes of performing systems level thermal analyses. The requirements for this model shall be established during instrument vendor/spacecraft contractor interface discussions. Refer to Section 4.6.3.6 of GSFC-S-480-13 (S/N 101-104) and GSFC-S-480-80 (S/N 105-109).

#### 3.3.1.2 Spacecraft Contractor

The spacecraft contractor shall be responsible for enforcing the requirements and restrictions imposed on the thermal interface.

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet 72 |

Interface hardware such as mounting brackets, mounting screws, washers, "loose" thermal isolators, reinforcement plates, cable insulation and multilayered insulation blankets used for interfacing purposes shall be the responsibility of the spacecraft contractor.

### 3.3.2 General Requirements

The thermal design of the instrument package and its implementation therein shall conform to all of the applicable requirements and restrictions specified in Section 3.4 of IS-3267415 (ATN-KLM General Instrument Interface Specification).

The thermal design of the instrument shall provide for minimal thermal coupling between the instrument and the spacecraft structure (ESM). In particular, the net orbit-average energy transfer rate between the instrument package and the ESM shall not exceed the values shown in Figure 14.

Thermal control of the instrument may utilize both passive and active elements.

### 3.3.3 Instrument Temperature Requirements

The allowable temperature ranges applicable to the instrument shall be as specified in Table 14. The thermal control provided for the instrument shall maintain the designated point-of-application temperature(s) within these ranges when the instrument is situated in the designated environment.

### 3.3.4 Spacecraft (ESM) Temperature Specifications

The spacecraft component (ESM) of the thermal interface is temperature-characterized as follows.

### 3.3.4.1 Operational Conditions

| ORBITAL SUN-ANGLE | MEAN INTERFACE (ESM) TEMPERATURE (°C) | ORBITAL VARIATION (C°) |
|---|---|---|
| 0° | 13 | ±1 |
| 27.5° | 19 | ±3 |
| 80° | 23 | ±3 |

The interface temperature will be within ±5 degrees C of the mean value shown. The maximum rate of change of this interface temperature shall not exceed 5 C° per hour at anytime on-orbit.

### 3.3.4.2 Survival (Safestate) Condition

| ORBITAL SUN-ANGLE | MEAN INTERFACE (ESM) TEMPERATURE (°C) | ORBITAL VARIATION (C°) |
|---|---|---|
| 0° | 5 | ±3 |
| 27.5° | 10 | ±3 |
| 80° | 10 | ±3 |

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| Size | Code Ident No. | |
|---|---|---|
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The interface temperature will be within ±5 degrees C of the mean value shown. The maximum rate of change of this interface temperature will not exceed 5 degree C per hour at any time on-orbit.
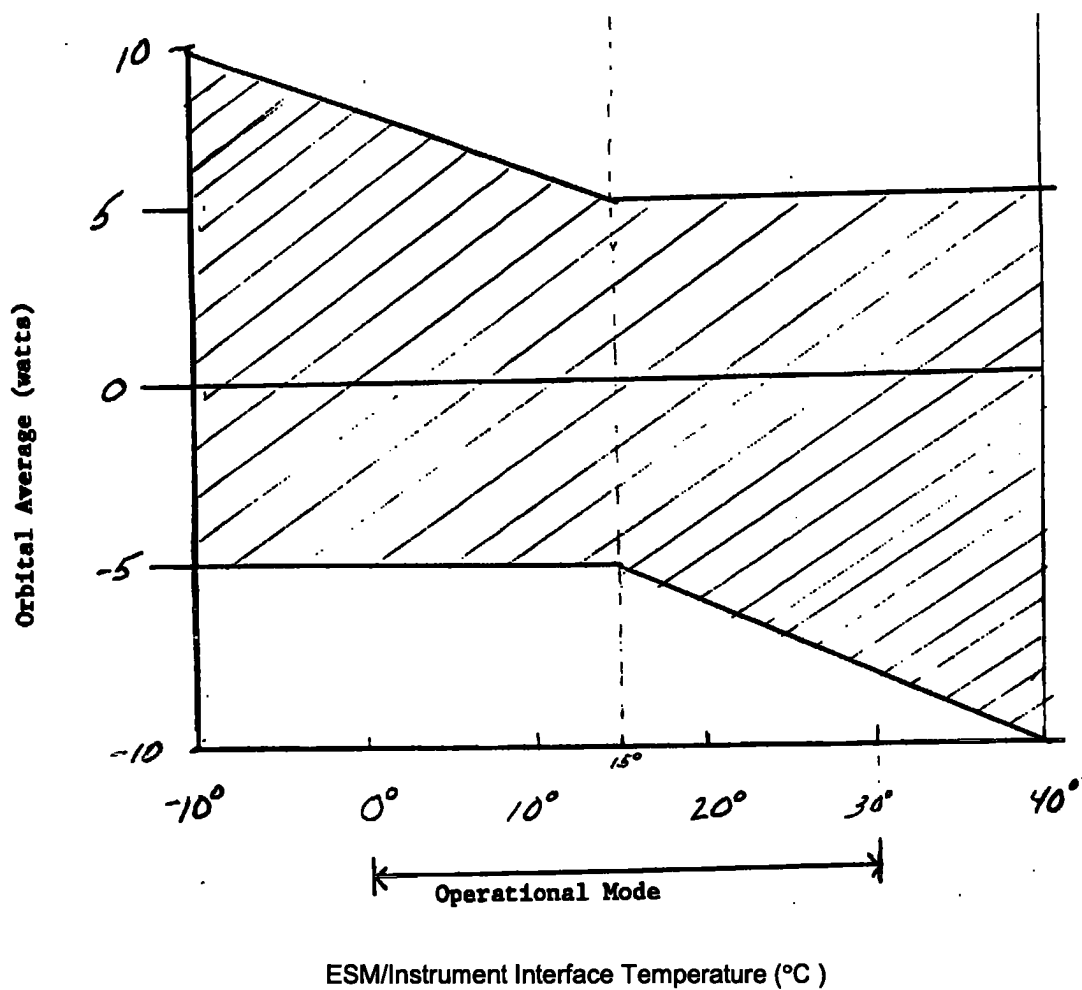


ESM/Instrument Interface Temperature (°C )

+ watts into ESM
- watts out of ESM

Figure 14. Orbit-Average Energy Transfer

| Size | Code Ident No. | | |
|------|----------------|---|---|
| **A** | **06887** | | IS-2617547 |
| | | | Sheet 74 |

### TABLE 14. INSTRUMENT ALLOWABLE TEMPERATURE RANGES

| | Temperature Range Definition | Range Limits (°C) MIN | MAX | Application Point |
|---|---|---|---|---|
| (1) | Allowable on-orbit operating temperature range; instrument data within specification. | -2* | +38* | Receiver Shelf |
| (2) | Allowable on-orbit operating temperature range; instrument data not within specification. | -20** | +58*** | |
| (3) | Allowable on-orbit non-operating temperature range; (survival range). | -30** -30** | +66*** +60*** | (for S/N 101-104) (for S/N 105-109) |
| (4) | Allowable on-orbit MIN/MAX turn-ON temperatures. | -12 | +48 | Receiver Shelf |
| (5) | Allowable in-air long term storage temperature range. | -15 | +50 | External Surface |

* Actual operating temperature range may differ based on actual performance of individual instruments and will be provided in the calibration data book.

** Coldest component.

*** Hottest component.

## 3.3.5 Instrument Thermal Control Components

The following passive and active thermal control elements shall be incorporated within the instrument.

## 3.3.5.1 Passive Control Elements

## 3.3.5.1.1 Surface Finishes (External) and Fixed Area Radiators

Details for these items shall be as specified in the following documents: Aerojet Dwg No. 1333964

## 3.3.5.1.2 Multilayered Insulation Blankets

Details for these items shall be as specified in the following document: Aerojet Dwg. No. 1333964.

## 3.3.5.1.3 Mounting

Instrument mounting details shall be as specified in the following document: Aerojet AE-26154 (Spacecraft Integration for the AMSU-A System).

### 3.3.5.1.4 Other

NONE.

### 3.3.5.2 Active Control Elements

### 3.3.5.2.1 Operational Heaters

NONE

### 3.3.5.2.2 Louver/Radiator Assemblies

NONE

### 3.3.5.2.3 Survival Heaters

1)      18.0 ohms ±5%
2)      Used when instrument is non-operating only
3)      Ground commandable with a thermostat overtemperature shutoff

### 3.3.5.2.4 Safety Heaters

1)      18.0 ohms ±5%
2)      Used at spacecraft integrator's thermal vacuum facility.
3)      Refer to Table 3a of this document for electrical connection.
4)      Maximum voltage applied shall be 40V.
5)      Thermostat over-temperature shutoff.

### 3.4 Environmental Interface

The instrument shall conform to Sections 3.5, 3.6, and 3.7 of the General Instrument Interface Specification, IS-3267415.

### 3.4.1 Magnetic Characteristics

The magnetic characteristics of the instrument shall be in conformance with Section 3.5 of the General Instrument Interface Specification, IS-3267415.

The following magnetic materials are used in the AMSU-A1:

1 - Samarium Cobalt - Motor Assembly
2 - Ferrite Material - Isolators and Latching Relays

The magnetic environment imposed by the spacecraft shall be as specified in Section 3.5 of the General Instrument Interface Specification, IS-3267415.

### 3.4.2 EMI

The AMSU-A1 shall conform to Section 3.6 of the General Instrument Interface Specification, IS-3267415. The exceptions to the above specification are as follows:

The AMSU-A1 shall operate without degradation in the presence of the electric field strengths in Table 15.

TABLE 15.  RF FIELDS AT AMSU-A1 INSTRUMENT

| Spacecraft Antenna | Instrument +Y Antenna (v/m) | Instrument -Y Antenna (v/m) | Frequency (MHz) |
|---|---|---|---|
| BDA | 2.9 | 2.7 | 137.35/ 137.77 |
| SBA-1 | 9.7 | 9.8 | 1698 |
| SBA-2 | 19.0 | 15.5 | 1702.5 |
| SBA-3 | 17.0 | 18.4 | 1707 |
| SLA | 10.0 | 10.5 | 1544.5 |
| VRA | 7.0 | 6.9 | 137.5/ 137.62 |
| SOA(1) | 4.8 | 4.6 | 1702.5 |
| SOA(2) | 4.3 | 4.2 | 2247.5 |

(1) Earth facing antennule.  Assumed to be co-located with the earth-facing antennule of another S-Band omni.  Normally only the beacon will radiate when the AMSU is on.  For both omnis radiating assume each one produces the given field strength and omit SBA-2.

(2) Earth-facing antennule of launch/emergency omni.

(3)  Field strength calculations are at the center of the instrument antenna.

### 3.4.3  Flight Environment

The AMSU-A1 shall survive the environment detailed in Section 3.7.3 of the General Instrument Interface Specification, IS-3267415.  Exceptions or special precautions which must be taken during exposure to these environments are detailed below:  AMSU-A1 shall meet the flight environment requirements as specified in GSFC document S-480-40, Performance Assurance Requirements for AMSU-A.

### 3.5  Operational Requirements and Precautions

### 3.5.1  Storage Requirements

(1)  General:  The AMSU-A1 shall be stored in its transit case.

(2)  Temperature Limits:  75 ±10°F

(3)  Humidity Limits:  Maximum Humidity 55%

(4)  Storage Pressure:  The AMSU-A1 shall be stored in its transit case.  The spacecraft contractor shall provide dry nitrogen periodically as required in the instrument O&M manual.

(5) Other: The AMSU-A1 shall be bench tested at least once every 9 months with the exception that it must have been tested within 6 months before being removed from storage for installation on the spacecraft.

## 3.5.2 Test Requirements

(1) General: The AMSU-A1 instrument, being a total power radiometer, is extremely sensitive to the ambient test temperature and temperature changes. Without a controlled environment and test targets, testing of the instrument is limited to an aliveness test. Variations in radiometer output response is normal when tested under uncontrolled conditions. This instrument is ESD sensitive.

(2) Handling: Specified in AE-26357, AMSU-A1 & A2 Handling Procedure.

(3) Temperature Limits:

Operating - Within Test Specification: -2 to +38°C (RF shelf)
Operating - Survival: -30 to +66°C for S/N 101 to 104 and
                      -30 to +60°C for S/N 105-109
Non-Operating (Not Powered): -15 to +50°C (Refer to Table 14)

(4) Cleanliness: All spacecraft tests shall be performed in a Class 100,000 cleanroom environment except for acoustics, pyro shock, T/V preparations, and during transportation. For these tests the instrument vendor will provide protective covers or instructions how to bag them with a protective film.

## 3.5.3 Operational Requirements

## 3.5.3.1 Command Sequences

Command sequences for AMSU-A1 operations shall be as follows:

NOTE: A minimum 18 seconds delay is required between subsequent AMSU-A1 commands.

Exception: No time delay between Module OFF Command and Survival Heater ON Commands.

## 3.5.3.1.1 Turn-On Sequence (In-Orbit and Test)

1) Send Survival Heater Power ON command (per spacecraft launch stored command table within 15 minutes of handover).

2) If RF Shelf A1-1 and RF Shelf A1-2 Temperatures are greater than or equal to -25°C, then proceed.

3) Send Survival Heater Power OFF command.

4) Send Module Totally OFF command to Not OFF (logic 0).

5) Send Module Power Connect command (S/N 101-109). Read L.O. Temperatures (Digital A) (S/N 101-104 only).

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|------|----------------|--|
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6) Send Cold Cal Position MSB command to 0 (logic 0).
7) Send Cold Cal Position LSB command to 0 (logic 0).
8) Send Full Scan command to ON (logic 1).
9) Send Scanner A1-1 Power command to ON (logic 1).
10) Send Scanner A1-2 Power command to ON (logic 1).
11) Send Phase Lock Loop Power command to Primary PLLO #1 (logic 1).
12) Send Phase Lock Loop Power command to Redundant (PLLO#2).
13) Send Phase Lock Loop Power command to Primary (PLLO#1).
14) Send Phase Lock Loop Power command to Redundant (PLLO#2).
15) Send Phase Lock Loop Power command to Primary (PLLO#1).

Note: Steps 16-23 apply only to S/N 101 to 104.

16) Delay 2 minutes.
17) If L.O. Temperature at Module Power Connect (Step 5) is < +5°C, wait until L.O. temperature is ≥ +5°C, then go to Step 19.
18) If L.O. Temperatures at Module Power Connect (Step 5) ≥5°C, skip Steps 19-23 (turn-on is complete).
19) Send Module Totally OFF command to OFF (logic 1).
20) Delay 20 seconds.
21) Send Module Totally OFF command to Not OFF (logic 0).
22) Send Module Power Connect command.
23) Repeat Steps 5 through 11.

NOTE:    Command 1 (Survival Heater ON) is not required for ambient turn-on

## 3.5.3.1.2 Turn-Off Sequences

### 3.5.3.1.2.1 Normal Turn-Off Sequence

(Instrument at zero power/predetermined instrument configuration)

1) Send Module Totally OFF command to OFF (logic 1)
2) Send Survival Heater Power OFF command.

NOTE:    This command puts both antenna in the warm cal position, turns off power to both scanners, and disconnects +28 VDC main and pulse load busses.

### 3.5.3.1.2.2 Emergency OFF Sequence

Instrument at zero power/under-determined instrument configuration.)

1) Send Module Disconnect command

NOTE:    Instrument power OFF - unknown state.

### 3.5.3.1.3 Safestate Sequence

(Known spacecraft condition/instrument at minimum power/predetermined instrument configuration.)

1) Send Module Totally OFF command to OFF (logic 1).
2) Send Survival Heater Power ON command.

### 3.5.3.1.4 Turn-On Sequence after Emergency OFF

1) Send Module Totally OFF command to OFF (logic 1)
2) Send Module Power Connect command
3) Delay 20 seconds
4) Perform Turn-On per Section 3.5.3.1.1

### 3.5.3.2 Test Turn-On Constraints

(1) Pressure: None
(2) Radiation: GSFC X-600-87-11
(3) Solar and Albedo: None
(4) Magnetic Fields: None
(5) Survival Heater Power must be OFF

### 3.5.3.3 Initial In Orbit Turn-On Constraints

(1) See Table 14, item 4
(2) Survival Heater Power must be OFF

### 3.5.3.4 AIP Switchover

If the AIP switchover occurs and the redundant side starts up with a random phase 8 second sync with respect to the original sync, the AMSU-A1 will resync itself at the next 8 second sync pulse.

### 3.5.3.5 Launch Configuration

Instrument power off and the antenna in the warm cal (stow) position.

## 4.0 INSTRUMENT INTEGRATION, TEST AND OPERATING REQUIREMENTS AND CONSTRAINTS

### 4.1 Test Equipment and Service

#### 4.1.1 Equipment to be Supplied by Instrument Contractor to the Spacecraft Contractor

The following is an inventory of the equipment that shall be supplied by the instrument contractor:

(a) <u>Special Test Equipment (STE)</u> - This unit shall be capable of operating the instrument in all its operating modes.

(b) <u>Contamination Covers</u> - This cover(s) shall be used to minimize the accumulation of contamination on optical surfaces both during the bench check testing and while the instrument is on the spacecraft.

(c) <u>Handling Fixture</u> - The handling fixture shall be attached to the AMSU-A1 at the time of shipment from the instrument contractor and shall remain attached to the instrument in its shipping container. It shall be used to lift the instrument from its shipping container and shall also be used to handle the instrument during bench operations. It shall be removed from the instrument prior to installation of the instrument on the spacecraft.

(d) <u>Thermal Blankets</u> - The thermal blankets are shown on the detailed drawing, Aerojet No. 1333964. These blankets shall be shipped with each instrument.

(e) <u>Connector Savers</u> - A set of connector savers shall be provided with each instrument. These connector savers shall remain on the instrument until it is integrated on the spacecraft and shall not be removed until after the IPF.

(f) <u>Optical Alignment Equipment</u> - A permanent alignment mirror shall be provided.

(g) <u>Thermal Vacuum Targets and Monitor</u> - (The following is for both AMSU-A1 and -A2). The thermal targets and monitoring equipment shall consist of:

2-A1 Targets - Aerojet Dwg. No. 1333150-5 & 6
1-A2 Target - Aerojet Dwg. No. 1333202-3

The following items are contained in one console:

-2 Mainframes Azonix No. MFE1-64-S1-110-60
-4 Expansion Chassis Azonix No. EXCC-02-110
-7 General purpose I/O boards Azonix No. GI05
-13 Mother boards Azonix No. AIB1
-25 RTD Modules Azonix No. RT44

(h) <u>Cables</u> - The cables required to connect the STE to the instrument shall be supplied.

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|------|----------------|---|
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(i)     Lifting Fixture - This fixture shall be attached to the instrument and shall allow the instrument to be mounted to the spacecraft when the spacecraft is in the vertical position. The fixture shall have provisions for lifting with a crane.

## 4.1.1.1 Special Test Equipment (STE) (for AMSU-A1 and -A2)

The Special Test Equipment (STE) shall consist of:
- a) Console Mod. Assy. - Aerojet Dwg. No. 1335696 and 1356655-1
- b) Monitor and Keyboard - Tektronix Model 4208 and equivalent
- c) Printer - Digital Model LA210 and equivalent
- d) Interconnect Cables - Aerojet Dwg. No. 5
  - W19  1335752
  - W20  1335753
  - W21  1335754
  - W22  1335755
  - W23  1335756
  - W24  1335757
  - W25  1335758

## 4.1.1.2 Calibration Test Equipment (CTE)

Refer to Para. 4.1.1.g.

## 4.1.1.3 Contamination Cover

The contamination covers shall consist of an electrostatic cover and an EMI cover, Aerojet Dwg. No. 1333135-1A.

## 4.1.1.4 Handling Fixture

The handling fixture shall be as shown in the Aerojet O&M Manual. The operation instructions for use of the fixture shall be given in the Aerojet O&M Manual.

## 4.1.1.5 Thermal Blankets

The thermal blankets shall be as detailed in Aerojet Dwg. No. 1333964 (S/N 102-104) and No. 1360083 (S/N 105-109). Blankets shall be installed by the spacecraft contractor per spacecraft contractor procedure TP-BLKT3278200 and Dwg. No. 8574806 (NOAA-L), 8574807 (NOAA-M) 8574808 (NOAA-N), 8574809 (NOAA-N'). The spacecraft contractor will determine the location of the velcro on the instrument blankets that mates to the spacecraft skirt blankets. The spacecraft contractor will attach this velcro to the instrument blankets per LMSSC drawing 8575174. The area where the velcro is attached will be covered by the spacecraft blankets.

## 4.1.1.6 Optical Alignment Equipment

The optical alignment cube shall be as shown on Aerojet Dwg. No. 1333964.

## 4.1.1.7 Lifting Fixture

The lifting fixture shall be as shown on Aerojet Dwg. No. 1333320 and drawing number T1291013-1. The operating instructions for use of the fixture shall be as given in the Aerojet O&M Manual.

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|---|---|---|
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## 4.1.2 Services provided by Instrument Contractor at Spacecraft Contractor facility

### 4.1.2.1 Bench Test

The Incoming Inspection - Electrical Bench Test (4.3.1.4) of the first Flight Model (Proto Flight Instrument) shall be performed by instrument contractor personnel. During the performance of this test the instrument contractor shall instruct the assisting the Spacecraft Contractor personnel in the use of the STE and the performance of the bench test. Instrument contractor personnel shall be available for subsequent PFM Bench Test(s) and for Bench Test(s) of the Flight Instrument as directed by NASA.

### 4.1.2.2 Data Analysis

There are no provisions to send instrument contractor personnel to the Spacecraft Contractor to review data other than informally or in a trouble-shooting mode as directed by NASA. Instrument contractor personnel shall be present at the Spacecraft Contractor during initial integration of the Proto Flight Model. As directed by NASA, the instrument contractor shall be present for selected system tests following the integration of the Proto Flight Model and for integration and test of the Flight Instruments.

### 4.1.2.3 Troubleshooting

Instrument Contractor and GSFC personnel shall be available to assist in troubleshooting as directed by NASA.

### 4.1.2.4 Warranty

There are no warranty provisions between the instrument Contractor and the spacecraft contractor. If repair of an AMSU-A1 is necessary NASA will arrange with the instrument Contractor to have them completed.

If the AMSU-A1 must be shipped back to the vendor, the spacecraft contractor will assure the unit is packed in the original shipping container.

The spacecraft contractor will arrange all transportation, at the direction of NASA, and intermediate storage to conform to the storage environmental limits in this specification. If the instrument to be shipped by air, the spacecraft contractor will escort the shipment to the air terminal.

The spacecraft contractor transportation office will make these arrangements based upon the local climate at the time of shipment. If for some reason these environmental limits cannot be assured, the shipment will be held, and NASA will be notified.

### 4.1.2.5 Equipment Maintenance to be Supplied by Instrument Contractor

As directed by NASA, the instrument contractor shall be responsible for maintenance of all test equipment delivered to the Spacecraft Contractor until the end of the contract, except for any designated, commercial test instruments which will be maintained by the Spacecraft Contractor. The test equipment to be maintained by the instrument contractor shall include the STE/CTE and automated data system.

Maintenance or repairs can be done at the Spacecraft Contractor, or, in the event any equipment needs to be shipped to the instrument contractor, the Spacecraft Contractor will accept responsibility for all transportation arrangements as defined in Paragraph 4.1.2.4 of this document.

### 4.1.3 Software to be supplied by the Instrument Contractor to the Spacecraft Contractor

#### 4.1.3.1 Bench Test Procedure

The Bench Test Procedure shall be supplied to the Spacecraft Contractor concurrent with delivery of the STE. The preliminary versions of this procedure shall be submitted to the Spacecraft Contractor as generated.

#### 4.1.3.2 STE/CTE (Calibration Test Equipment) Operations Manuals and Procedures

The ancillary manuals and procedures necessary for use of the various test equipment shall be shipped to the Spacecraft Contractor concurrent with delivery of the STE/CTE; preliminary version of these documents shall be submitted as generated. The documents covered by this paragraph shall be in the Aerojet O&M Manual.

#### 4.1.3.3 Data Book, Specification Verification and Calibration

A data book shall be supplied with each instrument. The alignment portion shall contain:

    (a)        Instrument Alignment to it mounting surface;
    (b)        Electrical boresights WRT optical alignment cube;
    (c)        Size, Weight and Center of Gravity of each module.

The calibration data shall comprise:

    (a)        Conversion equations for Digital A telemetry
    (b)        Conversion Equations for Analog telemetry

#### 4.1.3.4 Handling Procedures

The Instrument Handling Procedure, Aerojet O&M Manual shall be delivered with the Proto Flight Model. Preliminary versions of this document shall be submitted to the spacecraft contractor as generated.

### 4.1.4 Equipment and Services to be supplied by the Spacecraft Contractor for Direct Instrument Support

#### 4.1.4.1 Spacecraft Contractor Supplied Equipment and Services

    a.  Power Input at Test Location

        (1)    115 Vac, 60 Hz, Single Phase, 20 Amp. Service for STE
        (2)    115 Vac, 60 Hz, Single Phase, 25 Amp. Service for CTE

b. Floor Space to Accommodate the Following Equipment:

| | Size (Inches) | Weight (Pounds) |
|---|---|---|
| 1) STE | 33 x 21.5 | approximately 400 |
| Printer | 23 x 16 | 25 |
| 2) CTE - A1 Target | 11.4 x 9.9 | 40 (2 required) |

c. CTE Target:

$LN_2$ at 20 lb/hr flow rate and supply pressure at approximately 5 psi shall be provided by the spacecraft contractor for spacecraft level thermal vacuum. The thermal vacuum chamber cabling for the CTE shall be supplied by the spacecraft contractor.

d. Test Area

The spacecraft contractor shall provide a test area for the AMSU-A1 which meets the following environmental requirements:

1. Cleanliness: Class 100,000
2. Temperature Limits: 65°-85°F (18 - 29°C)
3. Relative Humidity: 55 Percent Max.

e. Standard Test Equipment

The standard test equipment shall be available at the spacecraft contractor to set up and troubleshoot the STE/CTE and to use during the bench test and post storage tests.

## 4.1.4.2 Spacecraft Contractor Supplied Labor for Testing at the Instrument Level

a. Proto Flight Model: - the spacecraft contractor shall assist the Instrument contractor personnel in performing the Bench Test.

b. Flight Models and Post Storage Testing: - the spacecraft contractor shall perform the Bench Tests. The bench test shall be performed at nine (9) month intervals on instruments not mounted on a spacecraft.

## 4.1.5 Test Access to the AMSU-A1

## 4.1.5.1 During Bench Checkout

All electrical interfaces to the instrument shall be through the AMSU-A1/Spacecraft connectors. There are test connectors on the AMSU-A1 but these are to be used only during the Bench Checkout, access to them will not normally be required.

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|---|---|---|---|
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### 4.1.5.2 During Satellite Level Tests

Access will be required to the instrument during the spacecraft level testing to remove the protective cover over the antennae. The covers will be kept on the scan cavity during all testing except the (1) RFI test, (2) vibration and (3) during the thermal vacuum test. During these tests precautions shall be taken to prevent dust and any other foreign material from entering the scan port.

### 4.1.5.3 Access for Inspecting Scan Antennae, Reflectors, and Thermal Mirrors

Access to the instrument will be required at WTR just before enclosing the spacecraft with the shroud for the purpose of: removing the protective covers on the antennae, inspecting the antennae, inspecting and cleaning the Thermal Mirrors, and to remove the sidemount safety heater.

### 4.1.5.4 During Launch Pad Testing (Shroud On)

There shall be no need for visual inspection of the instrument on the Launch pad. There will be no targets mounted in the fairing for the instrument use.

### 4.2 Acceptance Test Performed at the Instrument Vendors

The tests that are to be performed by the Instrument Vendors shall be as defined in the GSFC Specification for the ADVANCED MICROWAVE SOUNDING UNIT, Document No. GSFC-S-480-13.

### 4.3 Testing at the Spacecraft Contractor's Facility

The objective of testing the instrument at the Spacecraft Contractor's Facility is to assure compatibility of the instrument with the spacecraft and to demonstrate that the instrument meets its specified characteristics. The test program is divided into test performed on the instrument only, i.e. the Instrument Evaluation Tests; and on the instrument as part of the spacecraft system, i.e. the System Evaluation Tests and the Environmental Tests. The test flow is given in Figure 15. Test failures related to the instrument will be documented by a Test Discrepancy Report per operating instruction PAP E8.3 as specified in the Quality Assurance Plan, 3267412.

### 4.3.1 Instrument Evaluation Tests

The objective of the Instrument Evaluation Tests is to demonstrate that the instrument has the same characteristics at the spacecraft contractor as it did when tested at the instrument contractor's plant before shipment. At the completion of the Evaluation Tests the instrument is either put on the spacecraft or is put into storage to wait for later mounting. This evaluation test is divided into Receiving, Incoming Inspection Mechanical, and Incoming Inspection Electrical. Storage and storage retesting are also considered part of the Instrument Evaluation Tests.

### 4.3.1.1 Receiving

The objective of the receiving tests and inspection is to detect any gross damage during shipping and to verify delivery of documentation supplied with the instrument. The transit package shall not be opened during receiving inspection. Alignment and calibration and other instrument related data will be reviewed by the spacecraft contractor's Systems Engineering.

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|------|----------------|---|---|
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### 4.3.1.2 Incoming Inspection - Mechanical

The objective of the mechanical incoming inspection is to check for physical damage to the instrument and to document its condition as received at the spacecraft contractor. The state of the shock indicators shall be determined and the state shall be recorded. The instrument shall be weighed. This weight shall be used in establishing the full spacecraft weight. The mechanical inspection which requires the removal of the scan cavity dust cover shall be done in an environment which meets the Class 100,000 requirements.

### 4.3.1.3 Degaussing

The AMSU-A1 shall not be degaussed.

### 4.3.1.4 Incoming Inspection - Electrical (Bench Test)

The Bench Test shall be performed, to insure that the electrical and functional characteristics have not changed as a result of shipping. The STE shall be separately tested before being connected to an instrument.

### 4.3.1.5 Storage and Storage Testing

The AMSU-A shall be stored following the Incoming Electrical Inspection if not integrated on a waiting spacecraft.

The purpose of Storage testing is to assure that the instrument has not failed during storage. Instruments in storage shall be tested nine (9) months after the last bench test and every nine months thereafter. These periodic tests shall be comprised of a Bench Test.

Instruments which have been in storage more than six (6) months shall undergo a Bench Test before installation on the spacecraft. The requirements are given in Paragraph 3.5.1 of this specification.

### 4.3.1.6 Instrument Test Matrix

The instrument level and spacecraft level test matrix is given in Tables 16A and 16B.
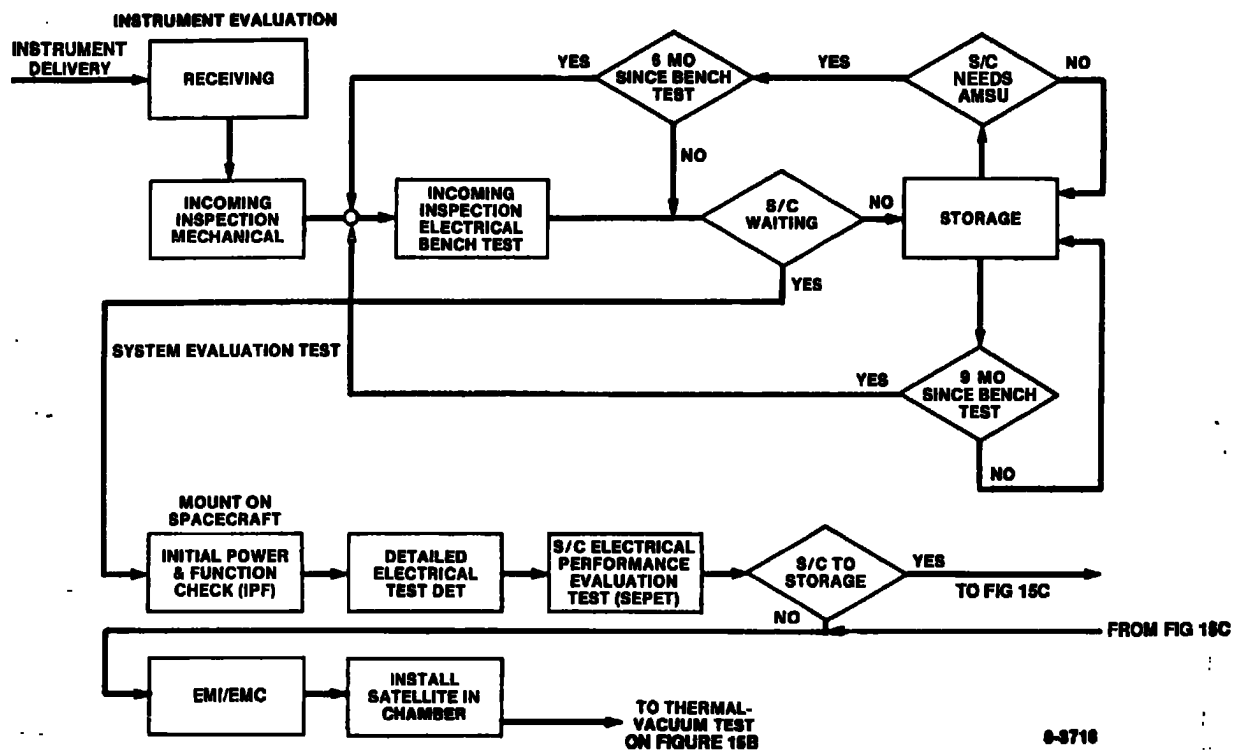
Figure 15A. AMSU-A1 Testing at the Spacecraft Contractor's Facility

| Size | Code Ident No. | |
|---|---|---|
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THERMAL VACUUM TEST

FROM FIGURE 15A → ALIVENESS TEST SAV → START PUMPING → LAUNCH TEST (AGS) → S/C OPERATIONAL TESTING (SOT)

SYSTEM PERFORMANCE SEPET T = 10°C → CALIBRATION ORBIT T = 10°C → S/C OPERATIONAL TESTING (SOT) → SYSTEM PERFORMANCE (SEPET) T = 15°C → CALIBRATION ORBIT T = 15°C

S/C OPERATIONAL TESTING (SOT) → SYSTEM PERFORMANCE SEPET (T = 20°C) → CALIBRATION ORBIT T = 20°C → S/C OPERATIONAL TESTING (SOT) → BREAK VAC & MOVE S/C TO I&T AREA

VIBRATION TEST

ESM/IMP OPTICAL ALIGNMENT → SEPET → VIBRATION PREPS → ALIVENESS TEST (SAV) → PRE-VIBRATION DEPLOYMENT

OPERATIONAL (PYRO) SHOCK* → ALIVENESS TEST (SAV)* → MODAL TEST* → ALIVENESS TEST (SAV)* → X-AXIS SINE VIBRATION

ALIVENESS TEST (SAV) → Y-AXIS SINE VIBRATION → ALIVENESS TEST (SAV) → ACOUSTIC VIBRATION TEST → ALIVENESS TEST (SAV) → CONTINUED ON FIGURE 15C

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Figure 15B. AMSU-A1 Testing at the Spacecraft Contractor's Facility (Continued)

| Size | Code Ident No. | |
|------|----------------|--|
| A | 06887 | IS-2617547 |
| | | Sheet 89 |
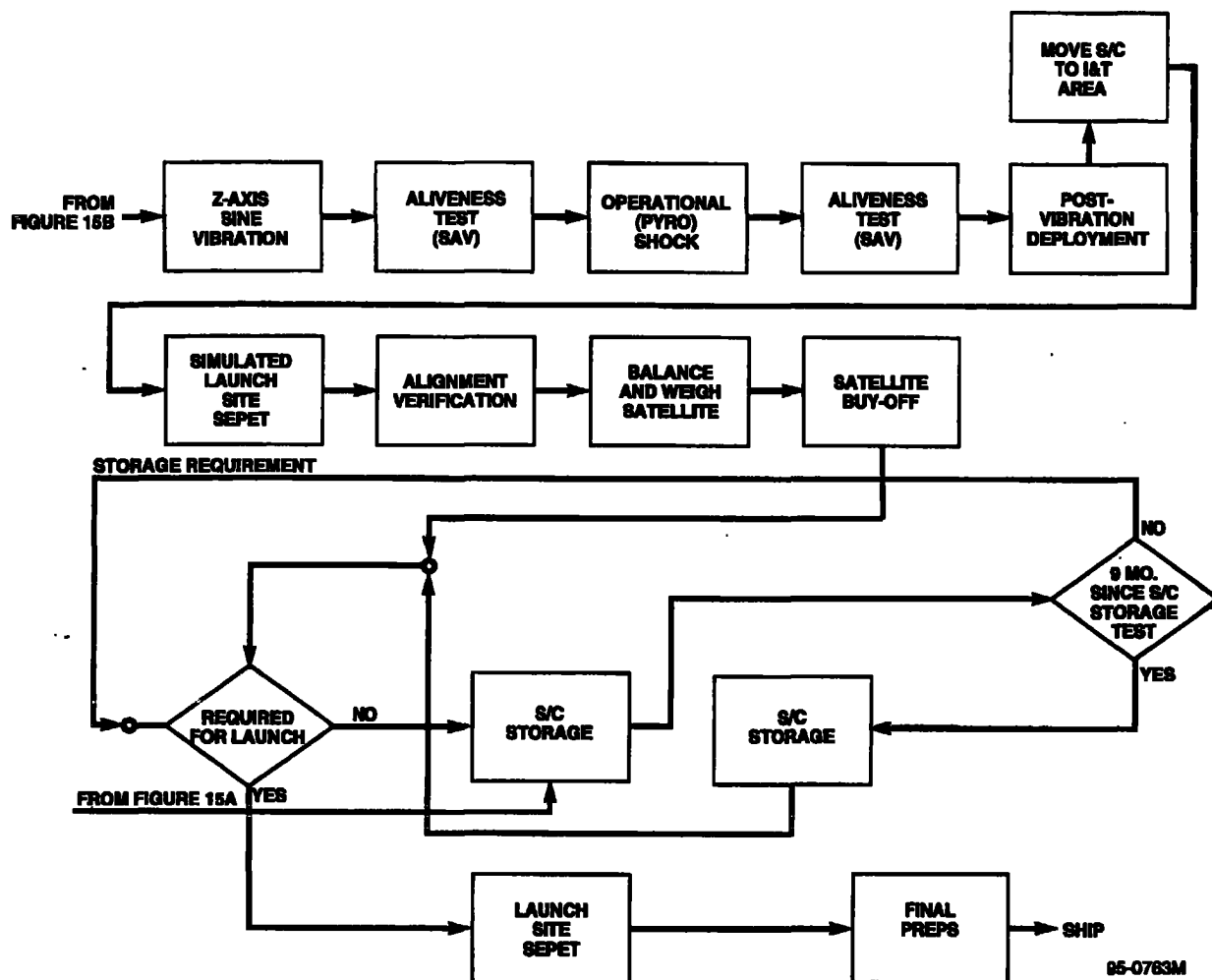
Figure 15C. AMSU-A1 Testing at the Spacecraft Contractor's Facility (Continued)

| Size | Code Ident No. | |
|------|----------------|---|
| **A** | **06887** | IS-2617547 |
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LAUNCH SITE TESTING

```
CONTINUED        RECEIVING        S/C ELECTRICAL        INSPECT          HEAT              ALIVENESS
FROM        →    S/C VISUAL   →   PERFORMANCE      →    LEAK CHECK   →   SHIELD       →    TEST
FIGURE 15C       INSPECTION       EVALUATION            N2H4 LOAD        INSTALLATION      (SAV)
                                  TEST (SEPET)

                 TRANSPORT        ALIVENESS             *MISSION         SIMULATED
                 TO          →    TEST             →    DRESS        →   FLIGHT       →    COUNTDOWN
                 LAUNCH PAD       (SAV)                 REHERSAL         (FIMFLT)
```

*NOT PERFORMED ON ALL LAUNCHES

8-3721
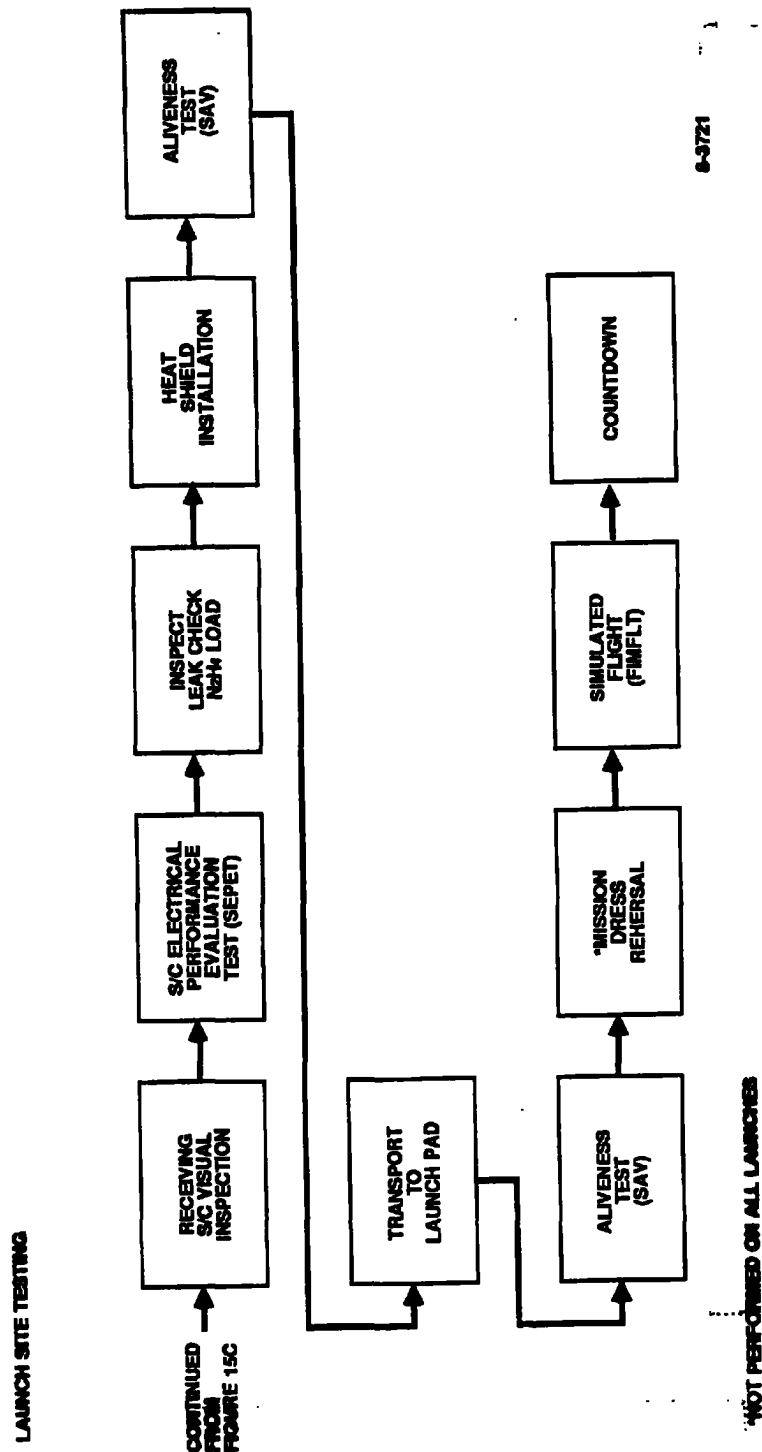
Figure 15D.  AMSU-A1 Testing at WTR

| Size | Code Ident No. | | IS-2617547 |
|------|----------------|---|------------|
| **A** | **06887** | | |
| | | | Sheet  91 |

TABLE 16A.  AMSU-A1 TEST MATRIX

| TEST | SYSTEM EVALUATION | | | | | THERMAL VACUUM | | |
|---|---|---|---|---|---|---|---|---|
| | BENCH TEST | IPF | DET | SEPET | ALIVENESS | AGS | SEPET | CAL CHECK |
| REFERENCE PARAGRAPH | 4.3.1.4 | 4.3.3.1 | 4.3.3.2 | 4.3.3.3 | 4.3.4.1 | 4.3.4.2 | | |
| POWER STATUS S/C PWR OFF | X | | | | | | | |
| S/C ON, AMSU-A1 OFF | | | | | | X | | |
| AMSU-A1 ON | X | X | X | X | X | | X | X |
| 1.  Ground Resistance Measurements | | X | | | | | | |
| 2.  Harness Verification | | X | | | | | | |
| 3.  Power Measurements | X | X | | | | | | |
| 4.  Input Signal Level Measurement | X | | | | | | | |
| 5.  Command/Mode Verification | X | | X | X | X | | X | X |
| 6.  Output Signal Level Measurement | X | | X | | | | | |
| 7.  Digital "A" TM Format Verification | X | | X | X | X | | X | X |
| 8.  Limit Check Digital "A" TM | X | | X | X | X | | X | X |
| 9.  Limit Check Analog Telemetry | X | X | X | X | X | X | X | X |

| Size | Code Ident No. | |
|---|---|---|
| A | 06887 | IS-2617547 |

TABLE 16B. AMSU-A1 TEST MATRIX

| TEST | ENVIRONMENTAL TESTS | | | | FINAL SEPET |
|---|---|---|---|---|---|
| | OPTICAL ALIGNMENT | SINE VIBRATION | ACOUSTIC VIBRATION | POST- VIB DEPLOYMENT | |
| REFERENCE PARAGRAPH | 4.3.4.3 | 4.3.4.4 | 4.3.4.5 | 4.3.4.6 | 4.3.4.7 |
| POWER STATUS S/C PWR OFF | X | | | | |
| S/C ON, AMSU-A1 OFF | X | X | X | X | X |
| AMSU-A1 ON | | | | | |
| 1. Ground Resistance Measurements | | | | | |
| 2. Harness Verification | | | | | |
| 3. Power Measure | | | | | |
| 4. Input Signal Level Measurement | | | | | |
| 5. Command/Mode Verification | | | | | X |
| 6. Output Signal Level Measurement | | | | | |
| 7. Digital "A" TM Format Verification | | | | | X |
| 8. Limit Check Digital "A" TM | | | | | X |
| 9. Limit Check Analog Telemetry | | X | X | | X |

| Size A | Code Ident No. 06887 | IS-2617547 |
|---|---|---|
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### 4.3.2 Mounting to Spacecraft

When the AMSU-A1 module is to be mounted on the spacecraft, it will be placed on a clean bench and the handling fixtures will be removed. The lifting fixture, after having been cleaned, will be attached to the module. The scan cavity dust covers will be checked for proper installation. The AMSU-A1 module will then be installed on the spacecraft.

### 4.3.3 System Evaluation Test

The objectives of the System Evaluation Test are to integrate the instrument to the spacecraft system and to assure that the AMSU-A1 meets all interface requirements.

The System Evaluation Test is divided into the Initial Power and Functional Check (IPF); the Detailed Electrical Test (DET); and the Spacecraft Electrical Performance Evaluation Test (SEPET).

For all tests the instrument is mounted on the spacecraft and the test data can be processed by the ATNAGE.

### 4.3.3.1 Initial Power and Functional Checks (IPF)

The objectives of the Initial Power and Functional Checks are (1) to provide an orderly method of verifying that application of power to the AMSU-A1 will not damage it or previously integrated subsystems; and (2) to verify that, after mating, the correct electrical interface has been established.

Correct operation of the instrument will be established by the use of breakout boxes and probes as required. Input signal voltages and power level measurements will be made on the spacecraft harness prior to mating with the AMSU-A1. Breakout boxes and/or probes may be used to expedite the measurement of signal levels and loading in all operational modes. However, the use of any breakout box or probe at the AMSU-A1/spacecraft interface will be subject to the following provisions: (1) all voltage taps will be protected against damage by external shorts pin-to-pin and pin-to-ground and no breakout box will contain more than one AMSU-A1 connector; and (2) all power level or current measurements will be made using clip-on induction probes and extender harnessing. The parameters to be tested during the IPF will be the following:

    (a)    Case Grounding - Verify case ground is firmly attached to the spacecraft ground.

    (b)    Harness verification - These measurements verify that electrical inputs to the instrument are on the correct pins. The presence of power on input pins, both full time and switched, is verified. Command functions on assigned lines are verified. Clock signals on assigned lines are verified. This harness verification is done prior to the initial instrument installation. If the AMSU-A1 is exchanged the harness verification will not be repeated. Resistance of all AMSU-A1 S/C Harness ground return lines will be measured.

    (c)    Instrument ground isolation - All power supply and signal grounds will be checked for isolation from the spacecraft ground before the spacecraft harness is connected.

### 4.3.3.2 Detail Electrical Test (DET)

The purpose of the Detailed Electrical Test is to demonstrate that the correct interface exists between the instrument and the spacecraft. The DET will include a functional checkout in which the instrument is commanded into each of its states to verify correct electrical and mechanical response. The Primary Contamination cover will be in place during DET testing. The parameters to be tested during the DET will be:

(a) Input Signal Level Measurement - The measurements of the clock signal and command signal levels are made to ensure that the instrument is supplied the correct amplitude signal and that the input of the instrument does not load down the driving circuit.

(b) Command/Mode Verification - Verification of the correct response to each command will be measured by the mechanical response and electrical output. Status verification will also be performed using Digital A Status Monitors and Digital B telemetry.

(c) Output Signal Level Measurements (Except for Radiometric Data) - The measurement of the output signal levels will be made to ensure that the instrument is supplying the correct levels to the spacecraft and the spacecraft does not incorrectly load the circuits. The measurement will also verify that signals exist at each of the outputs of the Digital B Telemetry and Analog Telemetry which corresponds to the operating function.

(d) Scan Operation Verification - The correct scan operation will be verified using the information output contained in the Digital A data stream.

(e) Digital A Data Format Verification - Verification of the Scientific Data Format will be demonstrated by the ability of the ATNAGE to decode and display all of the AMSU-A1 words contained in the Digital A data stream. In addition this test will validate the data base being used with the instrument.

(f) Analog Telemetry Verification - Verification of the operation of each of the Analog Telemetry points will be demonstrated by ATNAGE limit checking. This test will also verify the validity of the data base for the specific serial numbered instrument.

### 4.3.3.3 Spacecraft Electrical Performance Evaluation Test (SEPET)

The test has two basic objectives: (1) to demonstrate by measurement that the system meets all specification criteria; (2) to compare the data with previous measurements or establish the basis for future comparison. The SEPET is the most comprehensive ambient electrical test of the entire spacecraft.

The SEPET will be performed in a room temperature environment at atmospheric pressure.

(a) Command/Mode Verification - Verification of correct response to each command will be measured by the mechanical response and electrical output. Status verification will also be performed using telemetry.

(b) Limit Check - A number of Digital A telemetry words will be continuously limit checked in real time.

(c)    Limit Check Analog Telemetry - All analog telemetry will be limit checked.

(d)    Scan Verification - This test will verify the correct operation of the scan motor.

## 4.3.4 Satellite Environment Test

### 4.3.4.1 Aliveness Test

The aliveness test verifies that the instrument is correctly set up to enter a specific environment or has successfully passed the environmental exposure. The evaluation is accomplished by commanding the instrument through its orbital modes and status checking the data.

### 4.3.4.2 Thermal-Vacuum Tests

The purpose of the Thermal-Vacuum Test is to demonstrate the successful performance of the integrated satellite at temperature extremes in a vacuum environment.

The test will be performed with the spacecraft in the vacuum chamber at the spacecraft contractor's facility. The pressure will be less than $10^{-5}$ TORR and the walls of the chamber maintained at -65°C.

During the Thermal-Vacuum operation, the tests will be divided into AGS (launch simulation), Aliveness, System Performance, and Calibration check orbits. The function to be tested in each of these tests are shown in Table 16. Details of the test are given below:

(a)    AGS - A simulated launch test will be performed following pumpdown. The AMSU-A1 will be in its Launch mode.

(b)    T-V SEPET - The test has similar objectives to the SEPET performed in the ambient condition.

(c)    Calibration Check Orbits - The AMSU-A1 will be in a normal test mode. No special testing will be performed during the Calibration Orbits.

(d)    Transition Test - There will be no instrument testing during the time spacecraft temperatures are adjusted from one plateau to the next. However, the normal status monitoring and data processing will be done during the period of temperature transition.

### 4.3.4.3 Optical Alignment

The purpose of this test is to determine the field-of-view of the instrument with respect to the satellite primary reference, the Earth Sensor Assembly (ESA). The measurement made during this test will be to determine the differences in pointing direction of the surfaces of an optical reference on the instrument and the axes defined by mirrors on the ESA. The instrument will be mounted so as to meet the placement requirement of ±0.05 degrees in the X- and Y- axes relative to the ESA. This measured difference will be added to vendor supplied data which references the fields-of-view and axis to the instrument mounted cube coordinates.

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|------|----------------|---|---|
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### 4.3.4.4 Sine Vibration in X, Y, and Z Axis

The purpose of the sine vibration is to demonstrate the adequacy of the integrated spacecraft structure design. A low level (1/4 g or less) sine sweep will be conducted prior to the full level test. The results of the test will be used to verify the major critical resonances and adequacy of the individual components to withstand vibration in each of three orthogonal axis. The levels that the AMSU-A1 will see during the full level will be monitored to ensure that they do not exceed the level to which the instrument was qualified (Ref: GSFC-S-480-40, Rev. P). For S/N 103: Sine sweep test level shall not exceed 13G. After vibration testing inspect reflectors with X20 magnified lens for cracks or any other visual structural damage. The spacecraft will be vibrated in an all up flight configuration.

The AMSU-A1 module will be in its launch configuration. Some limited analog telemetry will be on during vibration. The scan cavity dust covers will be removed for this test. Between each axis of vibration the instrument will be inspected and an Aliveness test will be performed (see Figure 15).

### 4.3.4.5 Acoustic Vibration

The purpose of the acoustic vibration test will be to demonstrate that acoustically generated noise levels more severe than those expected during launch, will not adversely affect or damage the spacecraft structure or the payload instruments. For S/N 103: After acoustical vibration testing inspect reflector with X20 magnified lens for cracks or any other visual structural damage.

### 4.3.4.6 Post-Vibration Deployment Test

The instrument will be subjected to vibration as the result of deployment of some satellite equipment. The deployment tests have four (4) parts, (1) boom deployment, (2) cant deployment, (3) solar array deployment, and (4) antenna deployment.

The instrument will be in the Launch mode for these tests.

### 4.3.4.7 Final Electrical Check

The final electrical check will be a "Launch Site SEPET". This will be identical to the ambient SEPET.

## 5.0 NOTES

### 5.1 Waivers

The following waivers to the General Instrument Interface Specification (IS-3267415) have been granted for the AMSU-A1.

|  | Waiver | Date of Approval |
|---|---|---|
| Aerojet | D23 (CCR1250) –<br>Effective for S/N 103 only | 6/13/94 |
| Aerojet | Electromagnetic Interference (EMI)/<br>Conducted Emission<br>(CCR 1438-Rev-A)<br>Exception: Conducted emission<br>limits will be as per figure 16 for<br>AMSU-A1 S/N105 to 109. |  |
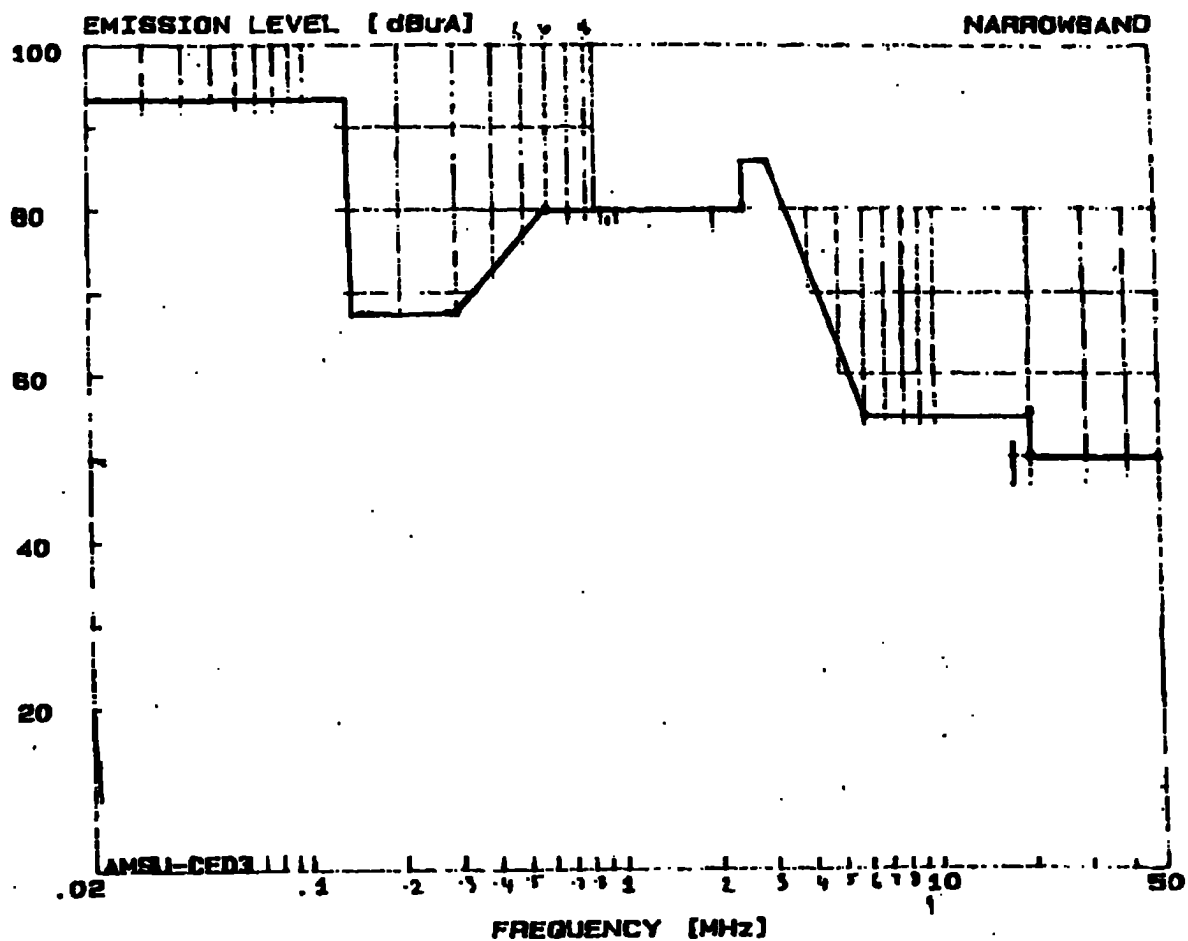
Figure 16. AMSU-A1 Conducted Emissions Limits (S/N105 to 109)

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# APPENDIX A

## REQUIREMENT DATES FOR AMSU-A1 INSTRUMENT DATA

| | | SCR | PDR | CDR |
|---|---|---|---|---|
| 2.1.2 | Instrument Contractor Originated Documents | | | |
| | Thermal Interface Control Drawing | | X | |
| | Outline Interface Control Drawing (Mechanical) | | X | |
| | Electrical Interface Control Drawing | | | X (+2 months) |
| | Top Assembly Drawing | X | X | |
| | Bench Check Test Procedure Delivery of Inst. | | | |
| | Bench Check Unit Operation Delivery of BCU | | | |
| | Instrument Handling Procedure | | X | |
| | Spec Verification and Calib. Data Book | Delivery of Inst. | | |
| | Reduced Thermal Model | | X | |
| 3.1.2.4 | Connector Keying Requirements | | X | |
| 3.1.3.2.1 | Power Dissipation (Table 4) | | X (+6 months) | |
| 3.1.3.2.3 | Load Current Ripple (Fig. 2) | | | X (+2 months) |
| 3.1.3.2.4 | Transient Loads (Fig. 4) | | | X (+2 months) |
| 3.1.3.2.5 | DC/DC Converter Frequency | | X | |
| 3.1.3.4.1 | Power Dissipation | | | X |
| 3.1.3.4.3 | Transient Loads (Fig. 7) | | | X |
| 3.1.3.5.1 | Power Dissipation | | X (+6 months) | |
| 3.1.3.5.3 | Transient Loads (Fig. 8) | | | X (+2 months) |
| 3.1.4.2 | Synchronization Signals | | X | |
| 3.1.4.3 | Commands (Table 7) | | X | |
| 3.1.5.2.1 | General Requirements | | X | |

NOTE: Where two X's appear for any item, the first X is the date by which preliminary date is required.

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|---|---|---|
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APPENDIX A (Continued)

| | REQUIREMENT DATES FOR AMSU-A1 INSTRUMENT DATA | SCR | PDR | CDR |
|---|---|---|---|---|
| 3.1.5.3.2 | Digital "B" Telemetry Points (Table 10) | | X | |
| 3.1.5.4.2 | Analog Telemetry Points (Table 11) | | X | |
| 3.1.6 | Operations | | X | |
| 3.1.6.1 | Input Test Points | | X | |
| 3.1.6.2 | Output Test Points | | X | |
| 3.2.1.1 | Dimensions | | X | |
| 3.2.1.3 | Moments of Inertia | | X | |
| 3.2.1.5 | Center of Gravity | | X | |
| 3.2.2.1 | Instrument Mounting Surface | X | | |
| 3.2.2.2 | Mounting Hole Position | | | |
| 3.2.5.1 | Reference Surfaces | | X | |
| 3.2.6.1 | Accessibility | | | X |
| 3.2.6.2 | Installation Requirements | | | X |
| 3.2.6.4 | Precautions | | | X |
| 3.2.7 | Inst. Material and Finishes | | X | |
| 3.2.8 | Spacecraft Harness Clamp Requirements | | X | |
| 3.3.3 | Temperature Design Limits | | X | |
| 3.3.4.1 | Finishes | | X | |
| 3.3.4.2 | Insulation Blankets | | X | |

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APPENDIX A (Continued)

REQUIREMENT DATES FOR AMSU-A1 INSTRUMENT DATA

| | | SCR | PDR | CDR |
|---|---|---|---|---|
| 3.4.1 | Magnetic Characteristics | | X | |
| 3.4.3 | Flight Environment | | X | |
| 3.5.1 | Storage Requirements (Temp.) | | X | |
| 3.5.2 | Test Requirements | | | X |
| 3.5.3.1 | Command Sequences | | | X |
| 3.5.3.2 | Turn-On Constraints | | | X |
| 3.5.3.3 | Initial Turn-On Constraints | | | X |
| 4.0 | Instrument Integration, Test and Operating Requirements & Constraints | | | X |
| 5.1 | Waivers* | | | |

*As necessary

APPENDIX B
ATNAGE SUBROUTINES FOR PROCESSING AMSU-A1 DATA

A. REAL TIME PROCESSING

Many of these functions require the instrument unique Software to be ON. Functions not requiring unique software are marked (*).

1. Raw Data Prints and formatted (Galoppo) prints.

2. Status Checking:

   a. Prints out a status report on commands
   b. Prints out when there is a "SCIENTIFIC DATA" status bit change. (Operator may inhibit from the keyboard).

3. Scan Verification: The correct position of each antenna in every scan mode is calculated. Errors are indicated when actual scan position does not agree with the expected position. The scan sync is also checked.

4. Limit Checker: The Limit check verifies that telemetry functions are within specified bounds. These bounds are established by data base and may be temporarily changed from the keyboard.

   *a. Analog Telemetry functions
   b. Digital A Housekeeping Telemetry functions

5. Radiance Monitor: Limit checks the warm and cold load radiometric channel output again high/low limits. Calculates scene temperature for thirteen radiometric channels and limit checks the differences between these values and the temperature of the cold load and warm load target temperatures. Also limit check the noise equivalent temperature difference levels of the thirteen channels.

6. *Command Verification: Telemetry status bits which are expected to change when commands are sent are verified by corresponders. The telemetry status to be verified is defined in a data base.

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